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PUBLIC WORKS

An Engineering and Construction Monthly

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CITY COUNTY STATE

PUBLIC WORKS is devoted to the design, construction, maintenance and operation of *public improvements.*

The major subjects covered are: Highways, Water Supply, Sewerage, Refuse Collection and Disposal, Street Cleaning, Bridges, etc.

Vol. 61 May, 1930 No. 5

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Forecasters and Prophets:

Happily the old saying that a prophet is not without honor except in his own country does not always hold. And some prophets do hit the mark. Our own Professor Folwell was so bold last year as to estimate the proposed highway expenditures for 1930 by a large number of the counties. If you will turn back to our May, 1929, issue you will find these proposed expenditures. Returns have just been received from a large number of these counties reporting the actual amounts spent last year. Turn to page 71 of this issue, and read how the actual expenditures were within 1% of the estimated expenditures. However, Mr. Folwell modestly states that he doesn't always come that close. In the same article you will find a prognostication for the coming year. Our predictions are: A rising barometer in the public works field.

Industrial Literature:

At the rear of this magazine are some pages printed on orange paper. Turn to them and you will find several hundred listings of data books, books, booklets and catalogs. Most engineers buy a minimum number of technical books and let it go at that. They too often neglect the many valuable contributions to technical literature put out by the firms manufacturing or selling engineering equipment. On page 133 and following pages you will find material well worth your attention. Any of these publications are yours for the asking. Look over the list, fill in the coupon on page 131, and mail to us. That's all.

Our New Numbering System:

A change has been made in the system of numbering the pages in PUBLIC WORKS. There was frequently some confusion with the old method of numbering, and we received quite a few letters asking for pages 35 and 36, these being usually lettered instead of numbered, or occasionally omitted. The numbers now run consecutively from the first page to the last.

In the Next Issue:

For the water works men who will meet in St. Louis early next month, there will be numerous articles. In addition to our annual statistical information contributed by superintendents from all over the country, there will be lists of waterworks and purification plants constructed in 1929; articles on reservoir construction, water works operation and maintenance, and finance. For those interested also in sewage matters, there will be the latest information on glass-covered sludge beds, report on a study of sewage treatment in Germany, and a group of other articles of interest to the sanitary engineer. For road men, there will be the second article on "Making the Road Money Go Further;" an article, with costs, on maintenance by contract; and two articles on mechanical finishing of bituminous pavements, in addition to many others.

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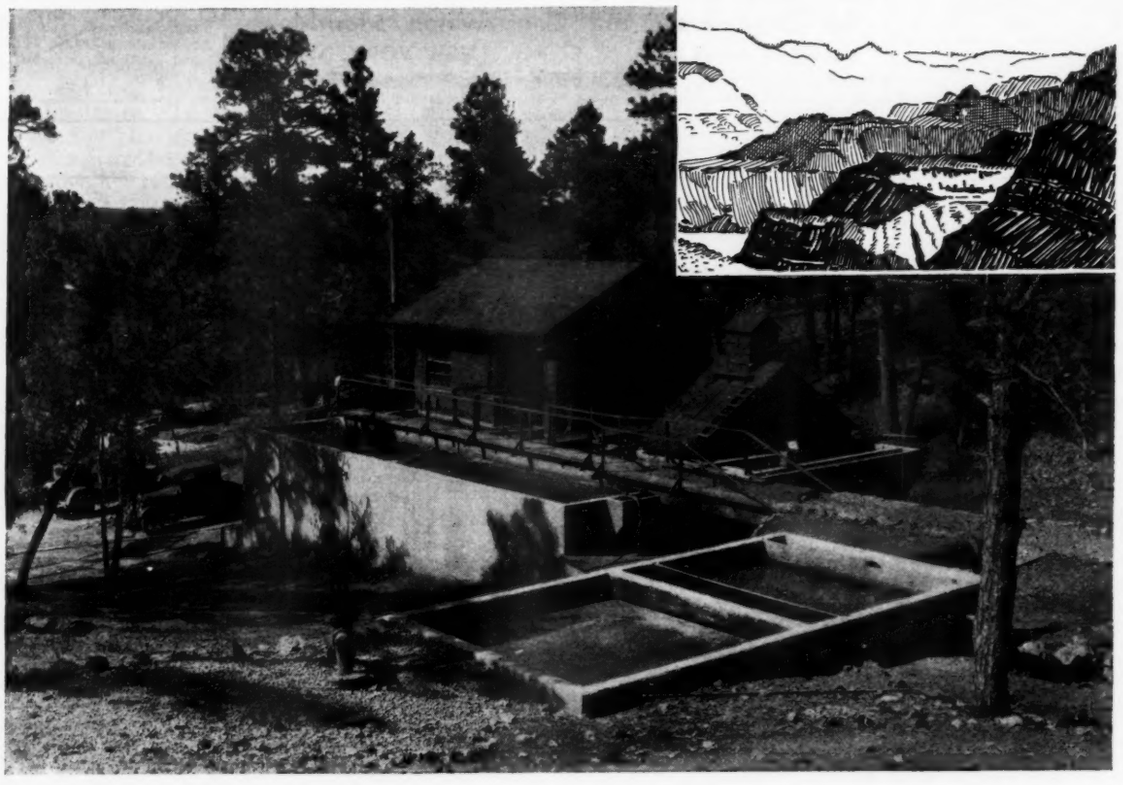

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Bulletins on the use of chlorine in sewage disposal will be sent on request.

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PUBLIC WORKS
CITY COUNTY STATE
AN ENGINEERING AND CONSTRUCTION MONTHLY

Vol. 61 May, 1930 No. 5

First Application of 45% Asphalt Oil on Shoulder, Salisbury, Conn.

Eliminating Wash-Boards on Macadam Roads

Keeping and draining water from the subgrade and proper application of surface material. Constant use of heavy hone and oiling twice a year, then covering with sand carefully selected for this purpose

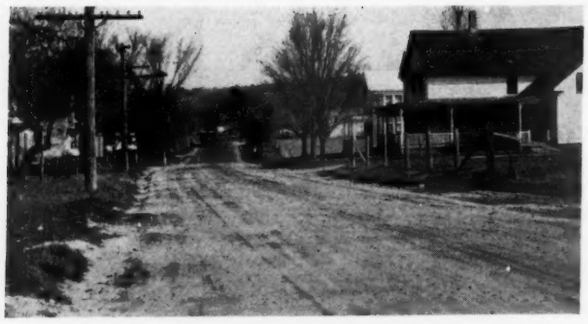
By N. W. Hardenbergh
Supervisor of Repairs, Connecticut State Highway Department

IT is generally agreed that insufficient drainage is the chief cause of many of the uneven and broken surfaces, especially of the older types of macadam roads; but of almost as great importance are the kind and quality of materials used in the construction of the road and the manner in which they were placed and the surface finished and rolled. In addition, the construction of shoulders, gutters and water courses has a great bearing on our ability to keep and maintain the surface in an unbroken and smooth condition. No amount of careful maintenance can ever counteract the work of a jazzy roller man or a shiftless inspector.

Shoulders are sometimes built of any material which is handy, such as muck, loam and even boulders and stumps. The use of such material invites trouble from water, frost and broken edges, especially in poorly drained or swampy locations. Instead of the shoulder holding away and shedding the water, thus keeping it from under the travelled path, it has acted as a sponge to hold the water and has turned the base course into a rubble drain which, with the washing away of the binder, softening of the sub-base and creation of excessive frost action, has caused the top to loosen and roll, weakened the whole substructure and created a condition that cannot be corrected or repaired without reconstruction of the whole section and the expenditure of money which would have paid far greater dividends had it been used in the construction of shoulders with materials suitable for the purpose.

We find in Connecticut that surface conditions are greatly improved by cleaning the shoulders of all vegetable growth such as grass and weeds and not allowing any sod to accumulate against the metal or surface section. The shoulders can then be kept smooth and tight up to the travelled portion of the road. During the past four years we have been maintaining our shoulders at least 4 feet wide, keeping them free from all growths and applying treatments of both asphalt and tar. This has reduced the cost of surface treatment and maintenance on the travelled portion of the road and has added from 4 to 8 feet to the driving width of the road. Another cause of wash-boarding is the

*Condensed from paper before Association of Highway Officials of the Northeastern States.



Tar-Treated Gravel Surface, ⅛ Gallon of Tar, With Cover. Not Yet Honed

improper preparation of the surface of macadam roads for the first application of bitumen. All newly construction roads before being filled or covered with bitumen should be thoroughly scoured and cleaned so that the voids in the surface will be free from all loose and foreign matters and a perfect bond with the bitumen be made.

Maintenance Methods

In maintaining such roads it is necessary to correct as far as possible the injurious conditions just referred to. Drainage can be improved by providing deeper and better waterways and keeping the water level as low and as far away from the travelled path as possible. Drainage of the sub-base must be attended to, especially where the soil is heavy and has a tendency to hold water. By thus keeping water from the underside of the surface, much labor is saved in repairs such as patching, sanding soft tops and dragging or smoothing the surface where all the bitumen has been loosened by the water and the surface has become rough and bumpy. The gutters and ditches should be located as far as possible from the travelled section, permitting building the shoulders with a flat slope, so as to create safer driving conditions for the public.

Rectification of a poorly constructed surface may require scarifying and rolling in very bad sections and further compacting surface which has been left in a very soft condition. It may be necessary to dig out the old base course and construct a new one, but this is seldom practicable and the only remedy then is reconstruction.

Honing, Same Day as Applied, New Application of Tar With Sand Cover

Up to five years ago Connecticut pursued the old methods of patching, oiling and dragging with light planes or hones, but has been compelled to adopt more modern, faster and better methods of maintaining and caring for bituminous treated surfaces, especially those which were continually becoming rough and wash-boardy. At times we have been compelled to remove all the mat of bitumen from the surface, especially where it was of poor quality or had been badly applied, or where it had been filled with material which seemed to rot and disintegrate the oil or tar. During these years a new system has been developed. Now the heating kettle is very seldom used by the repair or maintenance crews, for breaks are few and the need for patching is almost unknown. This condition has been brought about by the fact that we have found that a smooth surface seldom breaks; and we make careful and constant inspection of the surfaces of all bituminous treated roads and when we find they are becoming brittle, weather-cracked or worn, we immediately call out the oiling crews and apply to the entire weakened surface bitumen of the kind and quantity which

Former Location of Trolley Track (Now Removed) Filled With Gravel, Tar-Treated and Honed. The Stone Shows the Former Location of the Inside Rail

seems necessary. This was found to be better, less expensive, speedier, and more durable than patching or covering the small broken area from the heating kettle.

Where roads have become wash-boardy through poor construction, something more radical is necessary and for these roads we use an implement known as the heavy hone or drag. This we now consider the most valuable implement used by our Highway Department, for by its use we have been able so to recondition the surfaces of our older types of roads that they compare favorably with the later constructed macadam roads. These heavy hones are used not only on macadam but also on gravel, dirt, or any road that can be covered with tar or asphalt; and where it has been used, all roads look and ride alike.

Following honing, the road must be carefully treated with oil or tar and maintained afterwards. The proper application of oil or tar seems to afford the best if not the only economical relief from corrugation and rough surfaces. We have found

(Continued on page 92)

Tar-Treated Gravel in Norfolk Co., Ontario, Canada

Making the Road Money Go Further

Adapting the cost of treatment to the traffic to be carried. Use of surface treatment and retread methods

By Geo. E. Martin

Consulting Engineer, General Tarvia Dept., The Barrett Company.

WE are told that there are 3,001,825 miles of highways and rural roads in the United States and that 145,509 miles of state, and 376,406 miles of local rural roads have been surfaced; a total of 521,915 surfaced miles, or something less than 17 per cent. This mileage represents all types of surfaces. Presumably most of it is good, but unquestionably there are many miles of the so-called surfaced roads which are not very serviceable, and are probably impassable at certain seasons of the year.

We are told that our annual highway bill is in excess of two billion dollars. Every road user knows that, while adjacent to the large centers of population and on some of the major highways satisfactory pavements have been laid, one does not need to travel very far from any given point before being compelled to travel over roads that are roads in name only and fail utterly in their purpose of providing transportation for those compelled to use them. A modern, well built but expensive highway is useless to the man who lives at any distance from it if the connecting roads are unserviceable. There are many villages and towns that are isolated at certain seasons of the year due to impassable highways.

For the past twenty years most of the time and attention of the road builders has been devoted to design and construction of the main highways. Satisfactory but expensive types have been developed to care for their traffic, and while the construction program is by no means complete, it has made excellent progress. What is to be done with large mileage of local roads which are adequate to serve the people dependent upon them? There is not, and probably never will be, sufficient money available to pave these highways. Also, the vehicle-mile cost runs up to unreasonable figures for high-cost pavements on light-traffic roads.

Obviously, the first step is to grade and drain the existing soil and use that for a road surface. That is better than the wheel track across the prairie but still is dusty in summer and practically impassable after every rain. In some sections of the country the soil and climatic conditions are such that top-soil or sand-clay road surfaces of this sort do not break up badly in wet weather, but even under these most favorable conditions there is considerable dust when the road is dry.

Usually the next move is to surface the road with some granular material. Crushed stone, slag, and gravel are the materials generally used. The granular material is uniformly spread over the road surface to a depth of from two to four inches and kept smooth with a road grader or drag while being compacted under traffic. As the loose material is driven into the sub-grade and compacted by the vehicle wheels, new material is added. Such surfaces cost from $2000 to $4000 per mile, are easy riding, and can be maintained economically under very light traffic. They are always dusty, and maintenance costs increase directly with the traffic.

This type of road can be surface-treated successfully with tar if the road possesses sufficient structural strength to hold up the traffic. If the surface is solid and has practically no loose material on it, it is given

Tar-Treated Gravel in Vermont

a treatment of about one-half gallon per square yard of cold refined tar in two applications. The second application is covered with coarse sand or fine gravel. If, on the other hand, there is considerable loose material on the surface, the treatment is made by mixing cold refined tar and the loose aggregate with a blade grader on the road and tying this mixture to the solid material underneath by means of a prime coat of cold refined tar. Such treatments cost about a thousand dollars per mile for the first year, including the necessary additional maintenance. Subsequent treatments cost less because less tar is needed. Old gravel roads are treated in a similar manner.

Sand-clay and top-soil roads in the southern states are successfully maintained using a prime coat of a quarter gallon per square yard of cold refined tar and a seal coat of about the same amount of hot surface-treating tar covered with stone chips, slag, or pea gravel. The cover is rolled into the hot tar and a tough, impervious, skid-proof, easy-riding surface is produced. Such roads, including the necessary shaping up and surface treatment, may cost from $1500 to $3000 per mile, and where there is little or no frost action may last for several years without retreatment. Incidental annual maintenance costs on the surface itself have been reported as low as $85 per mile per year.

While these surface-treating methods give an excellent account of themselves, there are many instances where they are not quite good enough for the demands made upon them. Up to a short time ago there was no intermediate step between a surface treatment and a penetration macadam or other high-class type. The development of the type of construction called "Re-tread" has made available such an intermediate road surface. "Re-tread" is essentially a mixed-in-place tar concrete which can be placed over any existing road which is solid enough to hold up the traffic loads without displacement. The "Re-tread" top adds somewhat to the strength of the road and produces a pleasant appearing, easy riding, dustless, safe surface at a low cost.

In building a "Re-tread" surface, crushed stone or slag averaging about one inch in size is spread over the road to a depth of from two to three inches. A special refined tar is applied to the stone through a distributor in two applications, with a total of about three quarters gallon per square yard. The tar must be heavy enough to set up fairly rapidly but still stay plastic long enough to perform the necessary mixing operations. Mixing may be done with a blade grader or maintainer. The tar and stone are mixed after both the first and second application of tar. When the "Re-tread" has been thoroughly mixed and smoothed out, it should be rolled until solid. It is then sealed with about one-quarter gallon per square yard of the same special tar, covered with stone chips, granulated slag, or pea gravel, and rolled. It is opened to traffic immediately. Such construction does not require extensive apparatus and can be built very economically.

By a judicious use of the low cost road construction and maintenance methods which have been developed in the past few years, the highway official can improve his local roads without unduly increasing the tax burden on the community.

Oiling Secondary Roads in Oklahoma.

By Stoner K. McLelland,

Acting County Engineer, Tulsa County, Oklahoma

Tulsa County, Oklahoma, in the heart of the oil fields, during the fiscal year 1929-1930 surfaced 100 miles of the county highways with a double coat of 20 per cent asphaltic base road oil, 18 feet wide, with a 2½-inch penetration. It uses for this purpose 5-ton Liberty trucks equipped with 1000-gallon tank distributors, which are used 12 hours a day during the oiling season—the hot summer months when the roads are thoroughly dry. At the end of this season the distributors are removed and the trucks are used for hauling and road dragging.

During 1929 one and a half million gallons of oil was applied to 90 miles of the county highways. This treatment costs a maximum of $480 per mile the first year, with a reduced cost each succeeding year, sometimes running as low as $300 per mile. The maintenance cost averages $50 per mile, being zero in some cases. This gives an all-weather road for 365 days in the year for cross-country traffic, bringing every home within one mile of a surfaced road, as the county and state highways are laid out in a checker-board system of 2-mile squares. In preparing a road for oiling, the earth grade is smoothed out and levelled up by experienced tractor and grader men using 5-ton tractors and heavy road graders. After the first year, the road is first scarified with scarifiers attached to graders, and then thoroughly smoothed out with the grader, thereby getting the full penetration after the oil is applied.

We plan to take care of 150 miles in 1930. In addition to these, the county has 225 miles of concrete highways constructed during the past ten years.

1929 Road Work in New Mexico

During the past year New Mexico expended $1,200,000 upon maintenance of 5,400 miles of roads. There were 231 miles of roads oiled at a cost of $920,000. On the Federal Aid system, 84 miles of roads were built at a cost of $1,166,000. State construction in 1929 amounted to 820 miles costing $903,000.

Equipment for Refuse Disposal in Cleveland

Force and equipment employed in collecting. Garbage disposed of by the reduction process. Rubbish and ashes hauled to municipal dumping ground

By D. J. O'Neill, The White Co., Cleveland, O., and Charles C. Smith

THE Department of Public Service of Cleveland, Ohio, collects and disposes of about 130,000 tons of garbage and 665,000 cubic yards of refuse and ashes annually. The garbage is disposed of by the reduction process, the returns from which were said to have made the Division of Garbage self supporting from 1905 to 1920. Between 1920 and 1928 the returns did not cover the expenses, but in 1929 the total revenue of $305,000, realized through the sale of 4½ million pounds of grease and 13,000 tons of fertilizer, slightly more than covered the expense of operating the division.

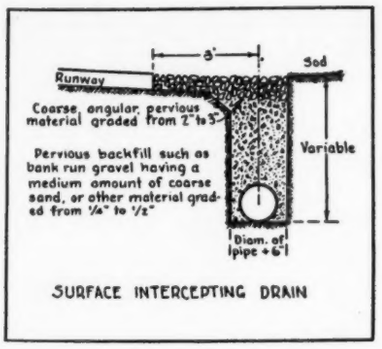
Household garbage collections are made weekly in all parts of the city, both winter and summer. Four men, including the truck driver, constitute a crew. The average length of a route is 3 miles and the average amount of material collected daily is 5 tons. The garbage division employs 350 men in all branches of its work, and 61 motor trucks form the greater part of its collection equipment. As the disposal plant is located at considerable distance outside the city limits, the garbage is transferred from trucks to railroad cars for hauling to the plant. The transfer station, which is located at a central point in the city, is designed for efficient operation. A broad ramp permits trucks to be driven onto a high dumping platform alongside the tracks, and the material is dumped from there directly into the railroad cars. All garbage collection trucks are equipped with rear dumping bodies and the railroad cars are of a specially built hopper type. The collection trucks are 3½-ton, most of them model 55 Whites, equipped with Wood bodies which carry tarpaulin for covering the garbage.

Rubbish and ashes are collected by the Division of Streets, which is thus able to use most of the "white wings" during the winter for the collection of household ashes. The average force employed by the division is 750 men. The equipment includes 150 trucks, 10 motor sweepers, 10 mechanical catch basins eductors and 16 street flushers. Most of the rubbish and ash collection trucks are 2½ ton Whites, equipped with hinged-side, rear-dump bodies with a capacity of 4 cubic yards. Two trucks, each with a force of four men, constitute a working unit, which covers a regular route, once every six weeks in summer and once every four weeks in winter. The average length of route is two miles, but the lengths vary greatly, depending upon the proximity of the dump, one route being 6.7 miles long in a thickly populated territory, while others are little more than a mile long. Seven municipal dumping grounds receive the rubbish and ashes, several of which are in marshy spots. Tractors equipped with backfillers spread the material

Garbage Truck (3½ Ton White) Dumping Into Specially Built Railroad Car at Transfer Station

Rubbish Truck (2½ Ton White) at Municipal Dump

Conrad M. Dombey, commissioner of the Division of Streets, believes that costs of that division have about reached a minimum, since motor equipment has been introduced generally and reached a high point of efficiency. Charles C. Smith, garbage engineer, attributes the self-sustaining record of last year to efficient operating methods plus a slight increase in the market price of grease. Several major changes in the reduction plant are contemplated and it is possible even that a new plant may be built.


3'
Sod
Runway
Coarse, angular pervious material graded from 2" to 5"
Pervious backfill such as bank run gravel having a medium amount of coarse sand, or other material graded from ¼" to ½"
Variable
Diam. of Ipipe +6"
SURFACE INTERCEPTING DRAIN

Drainage in Airport Design

To prevent surface erosion, flooding of field and frost action on runways, and give a firm surface and good sod. Designing subsurface drainage

By Harry E. Cotton,
Municipal Engineer, Armco Culvert Mfrs. Assn.

Fig. 2—Trenches Excavated in Ground Graded Perfectly Level, Laid Out Radially From One Point, So That Camera Has Unobstructed View of Each Trench. A Small Dyke Was Built Around the Tract

IT has been said that the popularity and advancement of air travel depend largely upon public confidence in its safety. If our air transportation system is to become established on a sound financial basis, it must furnish safe, continuous and dependable service during all weather conditions. Such service cannot be maintained when landing fields are unsafe for landing and taking off. The railroads have appreciated the importance of dependable service and have spent enormous sums of money in making their roadbeds immune to seasonal variation. Air transportation, too, must put its roadbeds on a similar basis before it can hope to gain and hold the public's patronage.

Many landing fields which, during favorable weather, as in midsummer, have "good natural drainage," may be entirely unsatisfactory during the rainy season of fall or winter, or in the early spring when the frost is breaking up. The field which does not need some measure of drainage is an exception.

On the other hand, drainage is not a panacea for all the ills of some landing fields. The soil conditions and the volume of traffic are the principal factors which will determine whether surfacing is needed in addition to drainage. Obtaining a safe landing surface is a separate and distinct problem for each and every airport.

The results which may reasonably be expected from a properly designed and constructed drainage system are as follows:

1. Erosion of surfaces on rolling fields is prevented by intercepting surface water at frequent intervals.
2. The flooding of the field, especially if a level field, is eliminated by the placing of surface drains at points of concentration such as at the foot of slopes, and at the edge of surfaced runways, taxiways, aprons, etc.
3. A firm surface is obtained by subdrainage.
4. A good stand of grass can be obtained by subdrainage provided the soil has crop-producing qualities.
5. Frost action which breaks up runway, taxiway, and apron surfaces can be eliminated or greatly reduced by subdrainage.

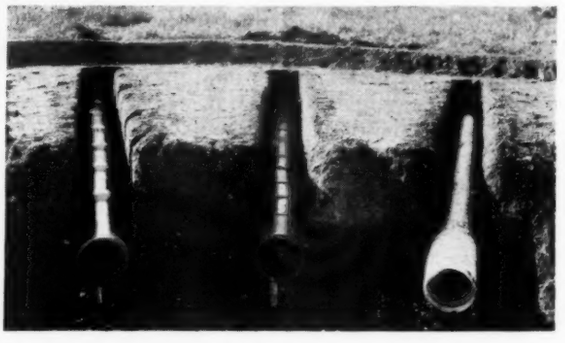


Fig. 3—Three Lines of 8-Inch Pipe, Each 12 Ft. Long. Bell and Spigot Pipe of 2-Ft. Lengths, Clay Drain Tile 1-Ft. Lengths; Each Laid With ⅛ In. Open Joints. Armco Perforated Pipe of Standard Design, Laid With Perforations Down; 5/16 In. Holes Spaced 1½ In. Centers Circumferentially in Each Valley of Corrugations, Through Lower 120° of Pipe. Each Line Laid at 1% Grade and Upper End Plugged

It will be noted that the first two desired results, listed above, can be obtained by surface drainage, while the last three are obtained by subdrainage. To obtain a satisfactory landing field it may be necessary to accomplish one or more, or even all, of the above results, and it is self-evident that a knowledge of local conditions as well as of the finished plan of the airport is absolutely necessary before the drainage plan can be laid out.

Surface Drainage Design

The removal of surface water on a landing field is one of the most important functions of the drainage system, and is necessary on nearly all fields. On sloping fields, surface water must be intercepted at frequent intervals to prevent erosion of the soil and

the formation of gullies. On level fields, the water must be removed quickly before it can soften the surface soil to such an extent that its stability is destroyed.

Airport drainage design is comparable to storm sewer design in that the storm water is carried away by means of underground conduits. In addition to this function, these conduits may act as subdrains for the removal of water from the soil. The design differs from that for storm sewers in the method of collecting the water. In storm sewer design, surface water is collected in and led to catchbasins or inlets by means of ditches or gutters, which are not permissible on an airport.

The method used to collect surface water on an airport—and the only one which has proved satisfactory—is to intercept the water by means of a trench filled with some porous material, such as gravel or crushed rock. The water flows down through the porous material, is collected in the drain pipe at the bottom of the trench, and then is carried away.

The accompanying photographs illustrate and describe a test made by the Armco Culvert Manufacturers Association at Middletown, Ohio, to determine the efficiency of this method of removing surface water from an airport.

The gravel trenches in this test allowed more water to pass through them than would be required in actual practice and yet were not taxed to their maximum capacity. They certainly have a much greater capacity than that of a pipe designed to remove an average maximum rainfall.

Engineers are generally recommending a somewhat finer material than that used in this test. A bank run gravel, the bulk of which is graded between ¼ inch and ½ inch, has proved to be satisfactory. It is claimed that the finer material collects silt at the top instead of allowing it to be carried to the bottom of

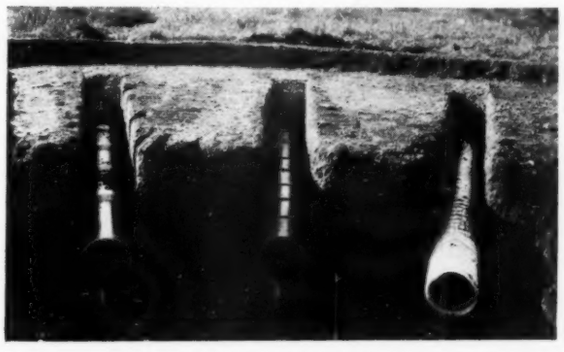


Fig. 4—Trenches Partly Filled With Gravel, Graded From ¼ to ¾ In., to Depth of 18 In. Above Pipe

the trench, where it may cause clogging of the drain. Also, the finer material lessens erosion of the sides of the trench because of the reduced downward velocity of the water.

Experience has shown that cinders are not a satisfactory material to use for this purpose because they tend to disintegrate and become packed so that water will not pass through. Their life as a water carrier is considered to be from three to five years.

The required size of pipe for airport drainage is determined in much the same manner as for a storm sewer, except that it must be remembered that water is entering the pipe through joints or perforations throughout its entire length instead of at manholes or catchbasins.

Rainfall data should be obtained from the nearest weather bureau station. A study of these should reveal the average maximum hourly rainfall. If it does not, the rate should be obtained from some reliable authority such as Meyers' "Elements of Hydrology." It is not economically possible to design an airport drainage system of sufficient capacity to remove the heaviest rainfall ever likely to occur as fast as it falls. A design based on the removal, within three hours from the beginning of the storm, of the runoff from an average maximum rainfall which is exceeded only once per year will be found to be rational and economical.

The percentage of rainfall which runs off over the surface depends upon the nature of the terrain, its slopes, and the character and condition of the soil. The determination of this factor is largely a matter of judgment with the engineer.

Airport drains, like storm sewers, are designed to remove the estimated runoff when flowing just full. When the runoff is greater than that which can be economically designed for, water may head up in the trenches and may even fill the trenches during a very heavy rain. Under this condition water will be forced into the drain pipe until the pressure on the inside is equal to the pressure on the outside. Sometime after the heavy downpour, or shortly after the rain has ceased, the pressure in the pipe at certain points will be greater than on the outside and water will be forced out through joints and all openings. This action may soften the soil under the pipe and may even wash the support away. The added capacity of the drains when functioning under a head may be taken advantage of if a pipe is used which will not disjoint under these conditions. Corrugated pipe offers the advantage for use for surface intercepting drains that the sections are securely connected together.

Design of Subsurface Drains

Most soils will support heavy loads when dry or approximately dry. Saturated soils are not only unstable, but will not grow a satisfactory sod and in the northern climates will freeze, causing heaving and the destruction of surfaces.

The conditions of the surface during the rainy season and in the early spring will generally determine the need of subdrainage. The nature of the soil

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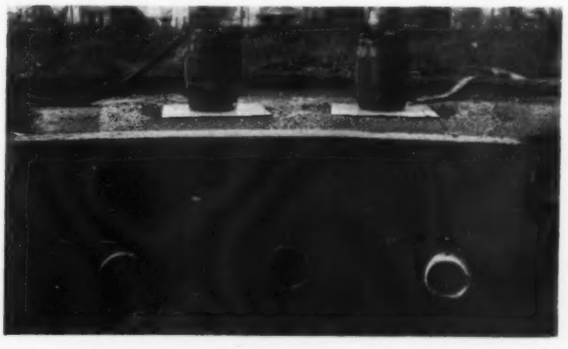
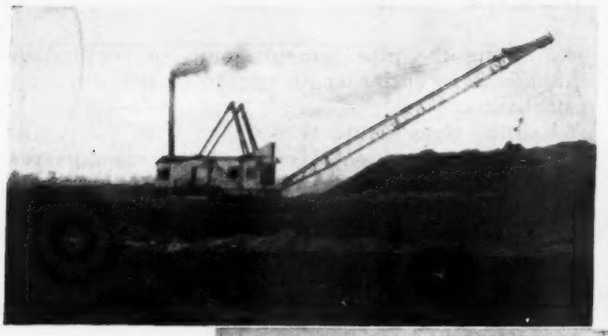
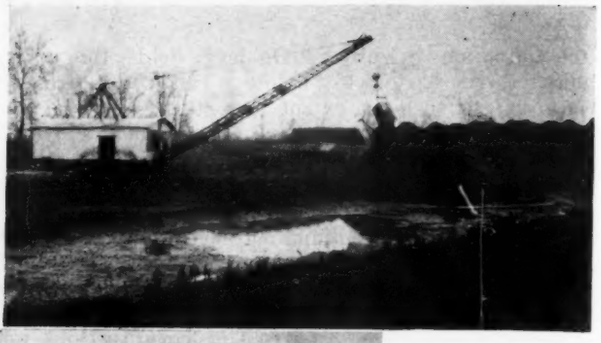


Fig. 5—Installation Complete, With Headwall in Place. Gravel Backfill Brought Up Flush With Ground Surface. Two Pieces of Sheet Metal and Two Barrels Used to Eliminate Erosion by Water From Fire Hose



Above: Bucyrus Steam Dragline, 115 Ft. Boom, 5 Yd. Bucket

At Bottom: The Dikes and Cross Dikes Built by Dragline



Above: Throwing Up Spoil Bank. Borrow Pit in Foreground

For Hydraulic Fill Construction of Levee

Dredges and Draglines in Levee Construction

Unusual amount of equipment used on job where the hydraulic method is employed to build the main body of the levee, draglines giving the final construction touches. Tower machine also used.

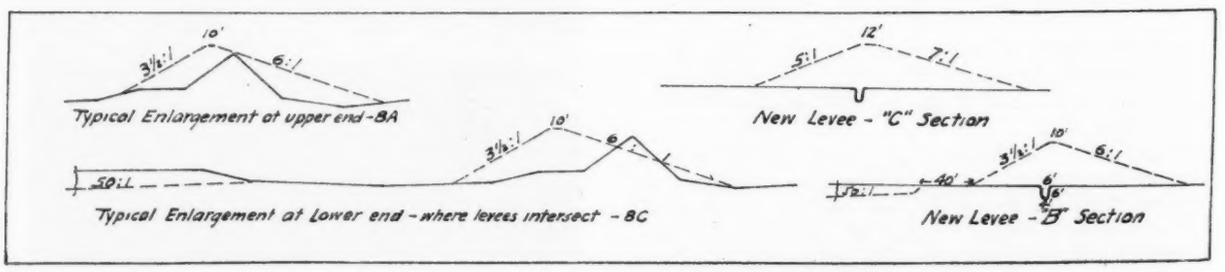
In the Reelfoot Levee District, which is located in the southwestern corner of Kentucky and the northwestern corner of Tennessee, considerable levee construction work is now in progress. This district, which contains 78,000 acres of land, is protected by about 21 miles of levee. The work now under way is chiefly loop levees; that is, levees built in the rear of present levees which are threatened by the river; but it includes also some enlargement work to conform to the increased grades called for by the Jadwin plan.

There are three major contracts now under construction in this district. These are of particular interest because of the variety of methods and equipment used in construction. On the work described in this article, hydraulic dredges are used to put in a portion of the levee, the final finishing being accomplished by a crew of draglines. On one of the other contracts, an industrial railway, with a power shovel for loading the cars and a small dragline for finishing the levee, is used; and on the other job, two draglines with long booms do the entire job.

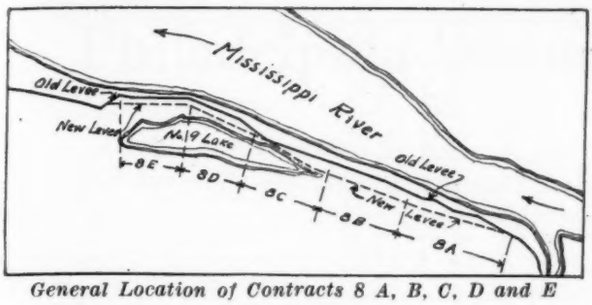
Contracts 8A, B, C, D and E, with a total contract yardage of 2,115,000 cubic yards, were awarded to the Sweet-Price Dredging Corp., Memphis, Tenn. The actual yardage will be somewhat in excess of this. Data on the individual contracts follow:

8A.—The work on this contract amounts to 410,000 cubic yards, on which the contract price is 28.4 cents per yard. The project begins about 11 miles below Hickman, or 51 miles below Cairo, Ill. The work, with the exception of 235 feet of "straddle enlargement" at the north end, is new loop levee necessitated by the threatened encroachment of the river. The material for the job is being obtained mainly from riverside borrow pits, but in some sections the old levee is being utilized for a portion of the dirt. The average height of this section is 17 feet, and the standard "B" section levee is used.

8B.—This contract forms an extension southward



Levee Sections Used on Contracts 8 A, B, C, D and E



General Location of Contracts 8 A, B, C, D and E

of contract 8A. The contract yardage amounts to 410,000 and the price is 28.4 cents per yard—the same as 8A. This section is wholly of new construction, and has an average of height of 20 feet. The material is secured from riverside borrow pits.

8C.—Contract 8C totals 430,000 cubic yards and has an average height of 19.5 feet; the contract price is 28.4 cents. The work consists of 660 feet of riverside enlargement of old levee and of new levee construction over the remainder of the contract. Material is obtained from riverside borrow pits and from the old levee.

8D.—This section has an average height of 20.5 feet and the contract yardage amounts to 430,000, on which the price is 28.4 cents. The work is new loop construction, tieing into section 8C on the north.

8E.—This section, which has a contract volume of 435,000 cubic yards and an average height of 20.0 feet, is the southernmost extension, and ties up into the higher land on the south of the district. The price on this section is 33 cents per cubic yard.

On all these contracts a period of 200 calendar days, from the receipt of notice to proceed with the work, is allowed for completion.

Construction Methods

The general construction method followed on the work is to put up dikes with a pair of draglines, and to place hydraulic fill from more distant borrow pits for the lower section of the levee, topping out from borrow pits near enough to be reached by large draglines.

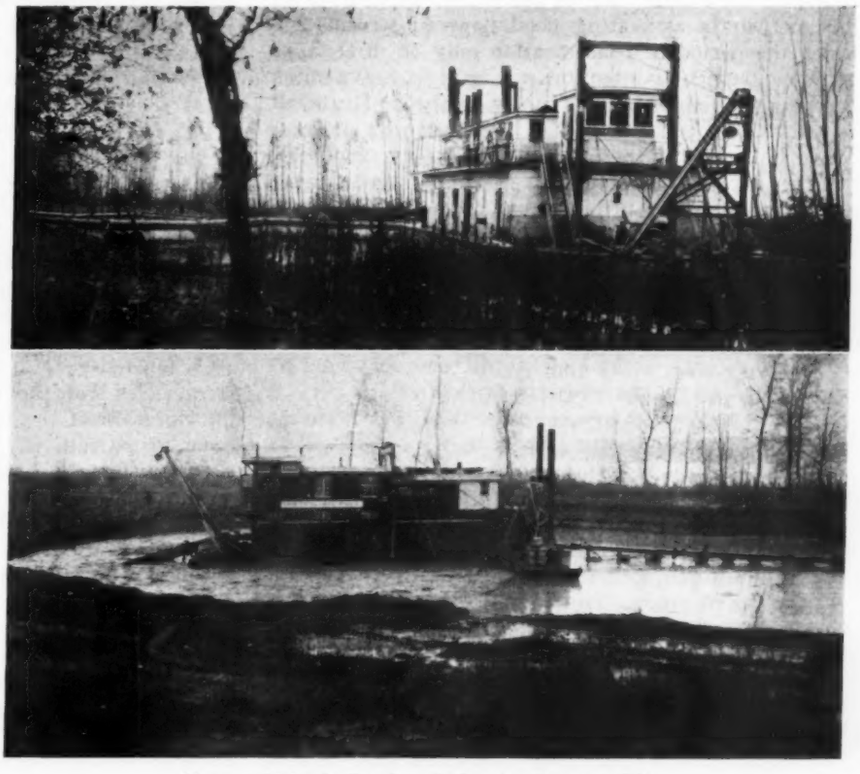
The dike forming the rear toe of the levee is constructed from material taken from the muck trench. The muck trench, which is required by specifications to be 6 feet wide on top, 4 feet wide at the bottom, and 6 feet deep, does not, of course, furnish sufficient dirt for the dike; but the contractor makes the excavation large enough to build up the dike. The dike forming the front toe of the levee is made from a borrow pit on the riverside of the levee. These dikes are usually about 15 feet high, with side slopes are about 1 on 1—the natural slope of the loose dirt—and dikes are spaced about 70 to 90 feet apart. They were built up with two Page draglines, a 2½-yard and a 3-yard, each having 73-foot booms. The draglines traveled down the levee right of way, both outside the base of the levee, piling up the dikes.

Into the space thus formed, and which is cut by cross dikes into sections 1000 to 2000 feet in length, hydraulic dredges pump fill material from borrow pits near the river. In forming these borrow pits, the dredges cut into the river bank and, when a sufficiently large space for working has been formed, build a dike cutting the borrow pit off from the river. Additional water is then pumped into the pit, raising the dredge as desired; return water from the levees is drained back into the borrow pits and additional water is provided from the river by means of a 12-inch gasoline driven pump, and also, when necessary, by the dredge itself. Generally, a height of about 15 or 20 feet above low water in the river is maintained in the borrow pits, and these dredges work against a head of 10 to 12 feet maximum, through about 600 feet of discharge line.

At present one 16-inch and two 12-inch dredges are employed. The 16-inch dredge is powered with a 360-h.p. Fairbanks-Morse diesel engine for the pump, and an additional 180-h.p. diesel engine is provided for the cutter head and other power requirements. The 12-inch dredges are both equipped with 240-h.p. Fairbanks-Morse diesel engines.

After the hydraulic fill has settled, which requires 30 to 90 days, depending upon the weather and character of the soil, the finishing of the levee is done by

(Continued on page 85)



Above—16-Inch Dredge Rides in Borrow Pit
Below—12-Inch Dredge at Work

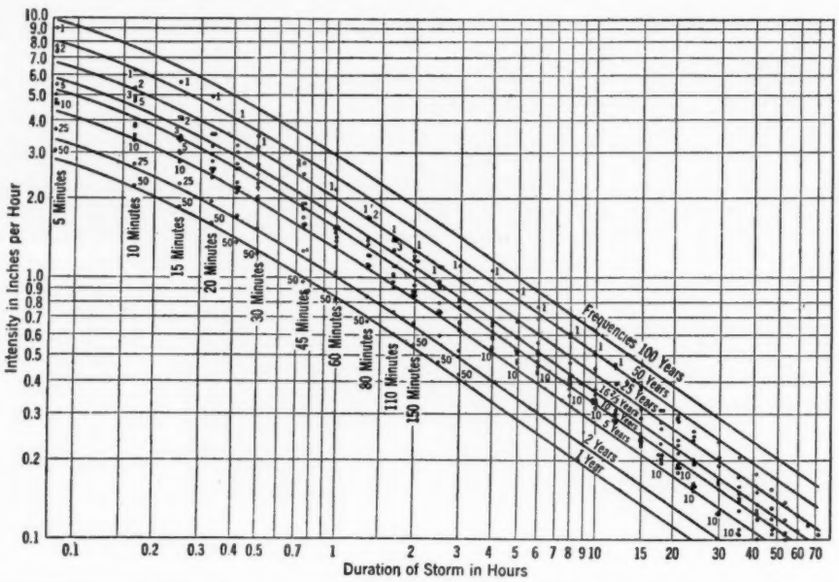


Chart Shows the Intensity of Precipitation at Boston for Various Durations and Frequencies of Storms.

Frequency and Intensity of Rainfall at Boston, Mass.

"IN view of the greater extent to which storm flow is now being estimated from rainfall, for periods of concentration as long as two or three hours, or even more, and of the recent application of this method in estimating flood flows of streams for which the period of concentration may be three days or more, particular attention was paid to heavy rains covering the longer periods" in an analysis of rainfall records taken at Chestnut Hill reservoir, Boston, Mass., covering a period of fifty years, made by Charles W. Sherman and given by him in a paper appearing in the April, 1930, "Proceedings" of the American Society of Civil Engineers.

In making this analysis, Mr. Sherman tabulated intensities for periods of 5, 10, 15, 20, 25 30, 45, 60, 80, 100, 120, 150 and 180 minutes, so as to obtain the fifty greatest intensities for each of these periods. Also, the records of the long storms were analyzed by hours to ascertain the greatest intensities for periods of from 4 hrs. to 72 hrs., so as to obtain at least the highest ten intensities for each of these periods.

In this analysis he terms as points of first magnitude those intensities which were equalled or exceeded only once in the 50 years; as points of second magnitude, those equalled or exceeded twice; and as points of fifth magnitude, those occurring five times, or an average of once in ten years. In general, the greater the frequency the greater the confidence with which the figures can be used.

The records were studied to determine also the significant data as to the time, with reference to the beginning of the storm, when the excessive precipitation actually occurred. They indicated that in most storms the precipitation is greatest at the beginning, and that the maximum rate occurs on substantially dry ground and therefore smaller run-off coefficients can be used with higher than with lower rates of precipitation. However, there had been heavy rains in which the quantity falling before the intense precipitation began was considerable.

The records of the significant storms were plotted on logarithmic cross-section paper with intensities as ordinates and durations as abscissas, and lines drawn for each of the several frequencies. These lines were nearly parallel, and quite closely represented by the formula

$$i = \frac{K}{(t+7)^{0.7}}$$

in which i is intensity of precipitation in inches per hour, t the period of time in minutes, and K a constant varying with the magnitude of the storms. For these records K varied from 16.0 for one-year frequency to 30.5 for ten-year and 34.6 for $16\frac{2}{3}$ years. Higher frequencies were not used in the calculation because the duration of the records, only fifty years, did not seem to warrant it. It was found that the formula $K = 16F^{0.27}$ satisfactorily represented the values of K within this limit, F representing frequency, in years. This gives a 10-year frequency 54% that for one year. The illustration shows curves plotted from this formula, and points plotted from the records, as explained above.

"It seems logical to assume," says Mr. Sherman, "that formulas of the same kind may be applicable in other localities," possibly with changes in the value of K only for a considerable area such as New England and New York. In other localities variations in one or both of the constants, 7 and 0.7, will probably be required.

The paper contains tabulated figures, diagrams and arguments supporting these conclusions.

Philadelphia Water Supply and Health

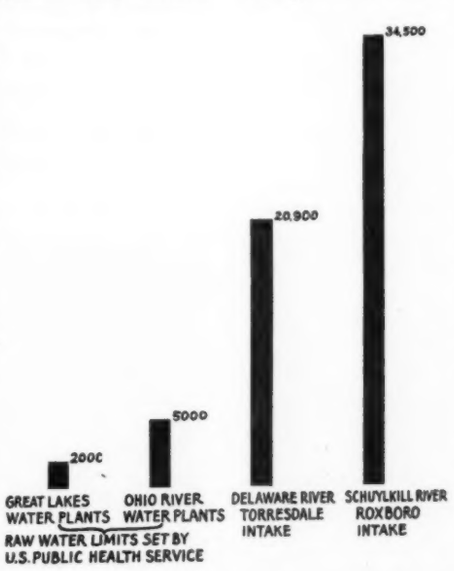
Rivers from which present supply is drawn are highly polluted, largely by the city's own sewage. Storage before filtration inadequate. Large number of cross-connections, violating ordinance

IN 1928 a group of men and women in Philadelphia, Pa., organized as the Philadelphia Hospital and Health Survey Committee in order to learn the facts concerning conditions of public health in that city, with a view to improving the same if possible. This committee, sponsored by the Philadelphia Chamber of Commerce, employed, for making a health survey, Haven Emerson, M.D., as director, Sol Pincus as associate for health studies, and Anna C. Phillips as associate or hospital studies. Work was begun by the survey in November, 1928 and continued through 1929, and the report has recently been made public. The largest part of the report and the study upon which it is based were devoted to subjects of social hygiene, maternity, public health nursing, organized care of the sick, etc. However, a few pages at the opening of the report are of special interest to municipal engineers in that they deal with water supply and sewerage in their relations to the public health.

Pollution of the Supply

The matter devoted to sanitation opens with the statement that the sources of Philadelphia's water supply "are so polluted as to cause the United States Treasury Department to withhold its certificate of approval for use of Philadelphia water in interstate commerce." Philadelphia's water supply is taken from the Schuylkill river through three intakes within the city limits, and from the Delaware river at Torresdale at the northern limit of the city. These rivers are the natural drainage courses for an extensively populated and heavily industrialized region. They receive the domestic sewage and trade wastes from communities on the Delaware and its tributaries, including Bethlehem, Allentown, Easton, Trenton, Burlington and Philadelphia itself; and on the Schuylkill river from Pottsville, Reading, Pottstown and Phoenixville. These wastes enter the streams after little or no purification.

The report refers to the limit permissible for raw water pollution when the water is to be used for a potable supply after filtration, as determined by the U. S. Public Health Service, as based upon a B. Coli index which does not exceed 5,000 per 100 cc. for the Ohio and similar rivers and 2,000 for the Great Lakes. As compared to this, at the Torresdale intake (from which 60 per cent of the city's water is derived) the raw Delaware river water shows an average pollution of about 21,000 B. Coli, while during the worst months of 1928 the index was 57,000. The Schuylkill river at the water works intakes showed an average B. Coli content varying from 16,000 to 34,500, with a maximum of 64,800.



Limits of Raw Water Pollution for Purifying to Drinking Water, Compared With Raw Water at Philadelphia Intakes

"The major pollution of the Delaware river is from sewage of the city of Philadelphia itself. There are 29 sewer outlets varying from 4 feet in diameter to 12 by 19-foot sewers, discharging wastes into the Delaware river about its confluence with the Schuylkill river. As the Delaware river is a tidal stream and has at this section a velocity at flood tide of 1.15 mi. per hour and a total flood tide travel of 5.95 mi. per tide, the wastes discharged far below the Torresdale intake will have influence on the raw water quality." The Bureau of Water has plotted "results of 125 float observations in 32 tides, which showed that approximately three-quarters of the floats set free off the Northeast sewage works travelled up to the Torresdale water intake and over half of the floats travelled as much as a mile above the intake. Bacteriological tests made of samples of water collected at various points along the river by the Bureau of Water showed the influence of Philadelphia's sewage was the predominant pollution factor as much as three miles above the Torresdale intake."

"The domestic sewage of certain city institutions and the section immediately adjacent to the Torresdale plant is brought to a collector and pumping station, treated at the Pennypack Sewage Plant and discharged into the mouth of the Pennypack Creek one-half of a mile away from the Torresdale water intake." This plant was first placed in operation some fifteen years ago and is now greatly overloaded, and moreover, was receiving practically no skilled supervision and was performing very poorly, and conditions about the plant showed extreme neglect. Moreover, the flow of sewage through the plant fluctuated from 1 million to 6 million gallons per day, which investigation showed was due to the clogging up of sewers and the bypassing of sewage from some of the large nearby institutions. In the spring of 1929 the entire sewage flow at the Holmesburg prison, including the waste from approximately 2,000 inmates, had frequently been discharged untreated directly into Pennypack Creek.

This pollution of the Delaware river so near a water works intake is considered so serious by the State Department of Health that it has prohibited the construction of additional sewer outlets or the making of additional connections to existing sewers which empty into the Delaware river near this point. Partly as a result of this, there are about 10,000 houses in the city which have privy vaults and 15,000 to 18,000 houses have cesspools, which number has been increased considerably during the past few years.

There is discharged into the Delaware about four miles below the Torresdale intake the effluent from what is known as the Northeast sewage plant, in which 40,000,000 gallons of sewage is treated by sedimentation in Imhoff tanks, this being about one-tenth of the present sewage flow into the Delaware. However, even this small amount of flow is allowed to bypass the treatment process at times.

In 1914 the city agreed with the Pennsylvania Department of Health that it would design and construct the necessary works for disposing of all its sewage, which would be in operation by 1930. However, as stated, plants for treating only 10 per cent of the sewage discharged into the Delaware river have been provided up to this time. A large collector known as the Frankfort sewage collector is nearing completion, which will bring an additional 80,000,000 gallons per day to the Northeast treatment plant, although no facilities have been provided at the plant for treating this additional amount. In other words, instead of decreasing the sewage pollution of the river, the amount of the additional sewage since 1914 due to the growth of the city is alone greater than the total amount of sewage now being treated. Moreover, although the Northeast sewage treatment plant as yet receives only about 60 per cent of its designed capacity, during 1927 it was bypassed during more than 2,000 hours.

An experimental plant has been constructed at the Northeast sewage works and experiments have been carried on with Dorr clarifying tanks, sewage filters, chlorination, sludge digestion, sludge incineration, etc.; and although some valuable results seem to have been obtained, and the officials of the Bureau of Engineering and Surveys claim that new methods have been worked out at the experimental plant which will completely solve the sewage treatment problem, no basis for such conclusions had been given by the expert in charge of the experiments. "For the past few years the support and maintenance of this experimental plant by the bureau officials has been of the scantiest possible, so that the chances of securing any very hopeful results under the present conditions are very slight."

As a result of these conditions, in the Schuylkill river below Fairmount dam and in the Delaware river above the confluence with the Schuylkill river, "millions of gallons of untreated sewage produced a very foul and objectionable condition, unsightly floating sewage material, septic conditions with bubbling up of sewage gases, and a desposit of sludge in pier slips. It has been stated that zero dissolved oxygen findings are generally encountered in the summer months, even along the upper Delaware as far as the Palmyra ferry, and that samples showing as low as 30 to 40 per cent of saturation for dissolved oxygen have been found at the Torresdale intake."

These conditions are of course realized by many of the citizens and in 1928 the mayor appointed Grover C. Ladner as a special counsel to take up measures for the reduction of the river pollution. "Very little support was given Mr. Ladner by the heads of the city bureaus or by the state authorities in securing complete data, determining an effective program, or carrying out legal measures. However, some successful results have already been obtained in that 19 polluting industries on the Schuylkill river had taken initial steps or agreed to remedy the harmful contamination contributed by them."

Filtration Plants

Water taken from these polluted rivers is treated in five filtration plants, which were originally constructed during the period between 1900 and 1912 and have had some improvements and extensions made, but still require extensive improvements to bring them to the point of first class condition to give reliable service. There is very scant preliminary storage available, little opportunity to obtain the benefits of prefiltration process or of shutting the intakes to the plants at times of worst raw water

The effluents from all of the plants are chlorinated but the rate of chlorine application is not regulated by the residual chlorine, but is changed with the number of B. Coli reported in the samples of the treated water. It was found at the Queen Lane plant that the additional application of a small quantity of chlorine to the water ahead of filtration is advantageous in reducing the bacterial load on the filters and producing a favorable effluent. This practice should, therefore, have been introduced at the other plants, but each of the plants is run on the individual policy of the filter plant superintendent or the general filter superintendent, rather than under the control of the sanitary engineer.

The final plant effluent during 1927 showed the average number of B. Coli per 100 cc. at Belmont as 3.23, at Torresdale as 2.60, at Upper Roxborough 1.19, Lower Roxborough 2.17, Queen Lane rapid filters 3.94, and Queen Lane slow sand filters 2.15. An examination of the monthly summaries for 1927 showed that the standard of water quality of the U. S. Treasury Department for interstate carriers was not met by one plant during 2 months, by another for 3 months, by three of the plants for 7 months, and by one plant for 9 months. Not since July 1925 has the Philadelphia water supply received approval of the Pennsylvania Department of Health or of the U. S. Public Health Service. Since October 1928 it has not been possible to compare the bacteriological results with the past results at Philadelphia or with the U. S. standards, since the chief chemist of the water bureau has been employing a new method of B. Coli determination (using brilliant green bile) instead of the recognized procedure given in the Standard Methods of Water Analyses of the American Public Health Association.

Cross Connections

Attention is called to the unsatisfactory condition of the matter of cross connections. "The record of Philadelphia in outbreaks of disease due to cross-connections is one of the worst published." In 1913, about 1300 cases of typhoid fever were traced to pollution of the city mains caused by dual piping systems in certain manufacturing plants. The Board of Health

(Continued on page 96)

Street Maintenance and Construction in a Small Municipality

Methods of constructing and maintaining gravel roads. Various uses made of calcium chloride. Concrete for pavement, sidewalks and guard rail posts

By A. T. Rhodes *

LEOMINSTER, Massachusetts, became a city in 1916. In 1926, when the writer was made superintendent of the Street and Sewer Department by Mayor Bernard W. Doyle, the city had about 22 miles of surfaced highway other than dirt or plain gravel, and a total public street mileage of about 110 miles. The mayor has acted on his belief that good roads are the best assets to a community, and in the four years since then about 34 miles of surfaced highways have been added, including those graveled from 8 inches to 12 inches deep with bituminous surface applications, penetration macadams, sheet asphalt on binder, reinforced cement concrete, and grouted granite blocks. All of this work has been done by the city forces, except the sheet asphalt on binder, for which we had no mixing plant.

Previous to this regime, the only road gravel accepted by the authorities came from a pit rich in clay for a binder, such as has made New Hampshire famous for its gravel roads. While this material is excellent for a plain gravel road, the writer considers it undesirable for a road which is to be surface coated, and thought it probable that material could be found locally which would serve better for our surfaced gravel roads. On investigation, large quantities of clean gravel were found in almost all parts of the city, and many excellent deposits of the finest grades of sand for sheet asphalt. We finally selected a pit which produced a sand grading 118% in comparison with standand Ottawa sand, as tested by the State of New Hampshire testing laboratories, and grade A stone, either of which would be acceptable for concrete construction on any state highway job in New Hampshire. Here we erected a crushing and screening plant.

On our many miles of rural dirt roads (many of them secondary lines) and on most of our residential streets, we used from 8 inches to 12 inches of bank gravel, which we load at the pit with a Keystone gas shovel, using a ¾-yard bucket, into Chevrolet, Ford, Federal and other 3½-ton trucks owned by the city. The larger stones are thrown off of the trucks, and the smaller ones, which are suitable for cobble gutters and shoulders, are picked out and left at the roadside for such use in the summer season.

This distribution of the gravel is done mostly in the winter time and, together with sewer construction, enables us to keep the summer crew busy during the winter. In case it snows, the snow is pushed aside where graveling is being done, and the work continued when the snow stops falling. In the case of sewer construction, we use steam boxes if the frost is too deep for easy digging, the steam for the boxes being supplied from idle steam rollers. Other winter work is referred to below.

When summer comes, the roads which have been gravelled are shaped, rolled, surfaced, dragged, and about 0.8 gallon of cold application tar is applied, covered with sand having plenty of pea gravel in it, rolled on a wet day or after sprinkling with water, exposed to traffic immediately and followed within two weeks with 0.2 gallon more of tar and covered with sand. This second application is considered to be absolutely necessary. Use of the surface by automobiles seems to help it except where they tear around street corners and here a third application is often necessary. The only injury to these new pavements seems to be done by the caulks of horses' shoes, but these are growing less and less. Many of these gravel roads are so loose, that we have difficulty rolling them and automobiles are stuck on grades; but after the blanket coat, they tighten up and come to a perfect surface, the tar reaching to a depth of 1½" to 2".

This penetration of the tar is why we prefer loose, clean gravel to the clay-bound gravel, since the bitumen lies on the latter as a top blanket and breaks

*Superintendent of Streets & Sewers, Leominster, Mass.

View, From Up Stream and Down Stream, of Washout of Bridge and 60 Feet of Concrete Road on Route 117. Washed Out About 5:30 A. M. Foot Bridge Opened to Travel at 10:30 A. M. At 10 P. M. the Same Day a Timber Bridge, Resting on Abutments of Railroad Ties, of 12 Feet Span, Double Planked, With Guard Rails and Lighted With Electric Lights, Was Opened to Bus and General Traffic and Continued in Service Until Concrete Culvert and Road Were Completed.

Department Forces Built This 86-Inch Trunk Sewer, 5,500 Feet Long, Lock-Joint Type, Using Local Aggregate

through easily. These gravel roads require a light surface application every two or three years, and some cold patch maintenance on spots where carelessness or tightly packed gravel did not allow proper penetration of the tar.

The most successful re-treating of the old surface is obtained by applying a spray of tar covered lightly with sand, allowing it to stand overnight, dragging with a heavy steel road hone and blanketing with tar and sand, after the Connecticut practice. Later, as traffic develops on these streets, we plan to apply a binder course and sheet asphalt top.

Due to the abandonment of one street railway system, we were faced with a problem of improving the streets, most of them bituminous covered pavements, where these old tracks were located, many of which were in a very rough condition. To take out the tracks meant a considerable disturbance of the pavement for a long period of time, and a cost at least one dollar greater than that of putting a sheet asphalt cover over the tracks under a five year guarantee. We believe that such a pavement will last for ten years, by which time the outside paving would need replacement and then the track could come up with the old pavement and the rails become the property of the city.

On some of the more heavily traveled residential streets in the city, we use crushed gravel and sand for a base course under a 2½" asphalt penetration trap rock top, which also is obtained locally. (We do not believe in anything but the hardest of stone for penetration top.)

Concrete Construction

Cement concrete has been used on some of our trunk line highways, including the north and south White Mountain-Providence route, and the east and west Boston to Fitchburg and Mohawk Trail route. We have constructed several sections of 7" reinforced concrete with thickened edges. In some places, due to probability of future underground construction, one strip of concrete has been omitted to allow for pipe installation in the street. Leominster used calcium chloride, both as an admixture and as a curing agent for concrete, before any other city in the state or even the State Highway Department. This enabled us to reduce the time of closing roadways to traffic from sixteen days to six days. By doubling the calcium chloride and cement quantities, we open factory driveways the following morning in the summer time; covering the drive with sand and laying plank on top. We have had no failures with this practice.

In fact, we use calcium chloride wherever we use cement—in roads, sidewalks, catch basins, manholes, sewer pipe joints and brick. In one case, we cast small piers to carry bridge beams where the bridge was an integral part of the highway, and on the following day placed the steel bridge beams and backed the concrete paving mixer across, concreting the beams and the floor slab as it went.

In constructing foot walks, the use of calcium chloride enables us to open the walk for travel the day after it is laid; also the previous day's work is not scratched up when the new work starts. Formerly, in using calcium chloride, we made a saturated solution of the chloride in water and used the solution on the basis of a pound of calcium chloride to a quart of solution. Some cement took two pounds and some would stand only one pound without accelerating too fast; in no event should over four pounds be used to a bag of cement. Now we use the powdered chloride, which does away with dissolving it in water.

We use half-inch expansion joint strips about every 25 feet of sidewalk, to prevent the walks from breaking the curb at street intersections or from buckling. Without these joints, the walks open at every joint in cold weather and the joints fill with dust, and then expansion occurs in hot weather with no space at the joints to allow for it. (Expansion may be as much as an inch for every 80 lineal feet of walk).

Forms Set for Cement Concrete Road, Built of Local Aggregate Produced by Municipal Crushing Plant

The walks are finished with a wood flot, the use of a smooth jointer and edger giving a panelled effect. The walks are made with 3 inches of a 1:2:3½ mix and 1 inch of 1:2 top mix, the sand for the top being screened through a ¼" or ¾" screen, which gives smoother results than a coarser sand. The base is made with sand joints about 5 feet apart, and the top is cut through over these joints with a pointing trowel. Excellent local material is found for these walks. The city pays half of the cost of them and is swamped with applications.

Some old granite blocks taken up in the car track area have been used for paving and also instead of curbing along the edge of cement concrete roads. They are laid on a dry mixture of 1:3 sand and cement, placed on a gravel bed, and are grouted with a 1:1 grout. The grout is mixed thin enough to run into the joints, which weakens it, but chloride is added which, with the rich mix, causes it to set up very quickly. By using the chloride grouting mixture streets of this granite block construction can be opened more quickly than a concrete highway.

Cement concrete is also used for guard-rails. We have originated a design of our own, using posts 6 inches square with chamfered corners, 7 feet long, with V in the top, in which is set vertically a ⅝-inch bolt long enough to pass diagonally through a 4 by 4 top rail. The two bolt holes for the bottom rail are formed by ⅜" gas pipe cut to lengths, which form separators between the sides of the forms of the fence

(Continued on page 98)

Maintenance and Repair of Asphalt Streets

By I. M. Goss
Deputy Street Commissioner, South Bend, Indiana

PUBLIC WORKS has asked me to write an article on repair and maintenance of streets and cost of the same—a subject which I think is of great concern to all cities at the present time. Of course all cities want to do their work as economically as possible, but I think the city of South Bend repairs its streets more cheaply than any other city that I know of, which it accomplishes by reclaiming the old asphalt.

South Bend is an industrial city. We have the Studebaker auto works, Oliver Farm Equipment Co., Bendix Brake Company, Singer Sewing Machine Company, South Bend Toy Works, South Bend Bait Company, Wilson Brothers Shirt Factory, South Bend Watch Factory, Kennedy Radio Factory, Bantam Ball Bearing Company, the Baumgartner Calender Specialty Company, the South Bend Flusher manufactured by Municipal Company, and about 150 others, which cause heavy local traffic. Also, two of the main national highways cross the city, the Dixie Highway, and U. S. 20, which gives the city heavy bus and truck traffic, in addition to a very heavy pleasure car traffic.

The city has a population of 115,000 and a total of 300 miles of streets. Of this total about 220 miles are paved, and of this about 70 per cent are of asphaltic material. A number of our streets are from twenty to thirty-four years old and this, combined with the fact that we have heavy industrial traffic, bus and truck lines, makes maintenance a serious problem.

For the year 1929 our city budget provided $19,580 for street repairs and we also received from the state gasoline tax about $35,000, making a total of approximately $55,000. One can readily see that with an average of only $250 per mile for the maintenance of our streets under the conditions mentioned, we must be economical in the extreme in order to keep our surface up to the standard now demanded by the traveling public. To accomplish this we have for several years been doing most of our asphalt repair work with the old material reclaimed from streets that are repaved. This material is secured during the construction season and stored in our yards until needed. It then is heated, retempered, tested and relaid so that it does the same work as would new material, with but very little cost for new material. We have been using this method for three years and find the wearing qualities equal to new material.

New asphaltic material costs us from $10 to $14 per ton here. During this year we have used 1347.1 tons in our repair work, but spent only $950 for new materials, so one can readily see the saving in this method.

Naturally most of our repair work (except cuts for water and gas service in a few cases) is on our old pavements, and the fact that these have 5-inch base, 1-inch binder, and 1-inch top, while those now constructed are 6-inch or 7-inch base, 1½-inch binder and 1½-inch top, materially assists us in keeping our streets in fair repair with the amount of money we have alloted to us.

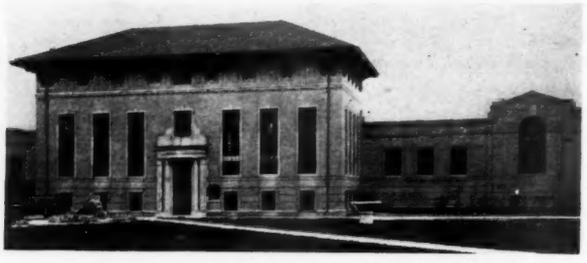
The plant we use for reclaiming this asphalt is an inexpensive outfit when compared with most reheating plants on the market, but its work is very satisfactory and will supply us with 6 to 7 tons of patching material each day. It has also the distinct advantage that it can also be used successfully for new material. This plant is one perfected by the writer and is the most reasonable in cost that he knows of, as it can be installed for about $1,000. We have used during the past year 1347.1 tons of material and covered 17,512 square yards of pavement at a cost of $15,882.94, or $.907 per square yard. A tabulated statement of the details of our expenditures is given below:

Labor and truck	$10,102.97
Foreman (entire 12 months)	2,400.00
Gasoline and oil	1,369.20
Emulsified asphalt	247.37
Coal	103.50
New A. C.	446.00
Repairs	201.10
Hauling old asphalt to yard	597.80
New tools	155.00
Other materials	260.00
Total	$15,882.94

The writer is proud of this showing and believes our methods will be of interest to those who, like ourselves, are trying to make a limited budget keep up with the requirements of a city that is growing very rapidly and the ever-increasing demands of the public for smoother and better-kept streets. We will be more than pleased to have anyone interested in asphalt repair come to South Bend and see how we do our repair work, or to give further information to those who are unable to come.

Piles of Old Sheet Asphalt Pavement Stored for Re-Use

Detroit's Springwells Pumping Station



Building Housing Detroit Filtration Plant

THE city of Detroit will soon begin the construction of a pumping station which it is claimed will be the largest single pumping station in the world. It is known as the Springwells Station and is expected to be placed in operation during 1932.

The present pumping plant is in Waterworks Park station, where several of the old steam engine driven reciprocating pumps have already been replaced with modern electric equipment. The new Springwells Station, which will be entirely electrically operated, is to be located approximately 14 miles from Waterworks Park and will take its water from the Detroit river through a new intake. From the intake the water will flow through a 14-foot concrete tunnel to a well 56 feet in diameter and 100 feet deep, from which it will be pumped into a filter plant. From the filter plant it will flow by gravity to the pumps, which will force it directly into the mains.

All of the pumping equipment in the new stations will be driven by electric motors. The low-lift pumps which raise the water to the filters will be centrifugal pumps, six of them being 750 hp units driven by synchronous motors, and two 350 hp driven by slipring induction motors. There will also be two smaller pumps for dewatering the tunnel, driven by two-speed induction motors; also two sump pumps. The eight large pumps will be furnished by the Worthington Pump and Machinery Corporation and the others by the American Well Works. The electric motors driving these and all the other pumps in the station are to be built by the General Electric Company.

The filtered effluent will be pumped into the mains by sixteen high-lift pumps, only twelve of which are being installed at present. Four will be rated as 1725 hp each, to be driven by synchronous motors running at 600 r.p.m.; two will be 1675 hp pumps driven by synchronous motors at 514 r.p.m., and two will be 1425 hp pumps driven by synchronous motors running at 514 r.p.m. The remaining four will be driven by slipring, variable-speed induction motors, two rated at 1400 hp and two at 1200 hp. All will be furnished by the Worthington Pump and Machinery Corporation.

Power for operating the plant will be obtained from a new power plant designed for an ultimate capacity of 30,000 kw. Auxiliary power in the station will be furnished by three General Electric turbine generators, each rated 500 kw. Steam will be extracted from the stages of the turbines and used for heating the building.

Construction Work on New Detroit Pumping Station

Chloro-Phenol Tastes

A German experimental plant installed by the Ruhrverband apparently indicated that removal of chloro-phenol tastes is best secured by filtering the water through activated charcoal. The plant with which the experiments were conducted, which had a capacity of about 6,000,000 gallons per day, successfully removed not only the chloro-phenol tastes but also those caused by algae and mineral constituents.

In the United States, more trouble has been caused by these tastes along the Ohio river than probably anywhere else, because of phenols discharged into the river by coke by-products plants. Through the joint efforts of federal and state governments and the industries concerned, the number of plants discharging phenol waste into the upper Ohio river was reduced from 17 in 1925 to only 2 in the autumn of 1928. A study of conditions along the Ohio river led to the conclusion, among others, that there was a progressive down-stream diminution of taste-producing phenol greater than could be accounted for by increased dilution by the river. The evidence indicated that this diminution may be due to a natural bio-chemical oxidation similar in general to other self-purification processes in streams.

They're smooth,

those streets and highways in the State of Iowa!

This street is just as smooth as it looks in the photograph. And it will stay smooth, almost indefinitely, because it is protected with Carey Elastite Expansion Joint, installed at frequent cross-intervals.

One of the principal highways through O'Brien County, Iowa, surface-smoothed for years and years to come with Carey Elastite Expansion Joint.

CONTRACTORS and road-builders in Iowa make a *thorough* job of it. They keep those highways through the prairies smooth (and the city streets, as well). They protect the concrete against expansion and contraction; and, at the same time, they safeguard their own professional reputations. With the original, pioneer Carey Elastite Expansion Joint!

The famous Carey Elastite Expansion Joint is made in "sandwich" form—asphaltic and fibre compounds, between sheets of asphalt-saturated felt. On high-speed highways and boulevards, in city streets, in bridges and dams and culverts, it protects concrete for years and years against expansion and contraction strains. An indispensable improvement—yet it adds but the smallest decimal to the total construction cost.

Write for the free "Elastite" manual on expansion joint installation.

Carey Elastite EXPANSION JOINT

THE PHILIP CAREY COMPANY *Lockland,* CINCINNATI, OHIO

For latest catalogs — consult the *classified* INDUSTRIAL LITERATURE section, pages 133 to 140.

Sewage Treatment at Schenectady

Average flow exceeds capacity of plant. Sludge in great demand for fertilizer. Prechlorination prevents odors. Controlling filter flies. Efficiency of plant excellent.

THE following information concerning the operation of the sewage treatment plant in Schenectady, N. Y., for the year 1929 has been taken from the annual report of Morris M. Cohn, sanitary and testing engineer of the Bureau of Sewage Disposal.

The trunk sewer which brings the sewage to the plant is of too small capacity, which involves a distinct hazard to certain sections of the city, and it is only by routine bypassing of quantities of sewage that damage to such sections is avoided. During the year the trunk sewer operated at full or over capacity the entire time. The surplus which the trunk sewer cannot carry is discharged into the Mohawk river and the State Board of Health has been endeavoring to persuade the city to remedy this condition.

Increasing the capacity of this sewer would necessitate increasing that of the plant, since the plant can handle the sewage now brought to it by the sewer only by careful adjustment of the flow and occasional bypassing at the plant. The average flow through the trunk sewer for the year was 8.74 million gallons per day, while the average treated by the treatment plant was 8.13 million gallons. Thus an average of 0.61 million gallons of sewage was wasted over the plant overflow directly to the river, in addition to that which could not be carried by the sewer.

The trash collected by the bar rack is plowed under the soil regularly every week during the summer, and that accumulating during the winter is shallow trenched in the spring. Test borings in the trenching plot show that material buried four years ago has completely undergone decomposition.

Sludge from the Imhoff tanks is dried upon sludge beds and the market for this dried sludge has persisted and by the end of 1928 the farmers had removed the sludge from all the drying beds and rough-raked the beds in search of additional material. In the fall 1929 practically all of the sludge was taken from the fields and it was hoped that the beds would be cleared during the winter months. The price charged was 25c for a normal load, but a few using very large trucks have been charged on a basis of a double load. No sludge was allowed to be taken from the plant until after August 1st, this provision being made to prevent the use of sludge on produce grown and eaten that year. Analyses of representative samples of field stored sludge showed it to contain, on a dry basis, 1.07 per cent phosphoric acid, equivalent to 2.33 per cent bone phosphate of lime; 1.72 per cent nitrogen, equivalent 2.09 per cent ammonia; and 6.40 per cent ether soluble matter.

In his discussion of the Imhoff tank, Mr. Cohn says that the observations this year indicate clearly that the application of water to gas vent scum induces active foaming.

All efforts were exerted to maintain the tanks in non-odorous conditon. A manual-controlled MDA solution feed chlorinator was installed in the screen house and prechlorination of the crude sewage entering the first battery of Imhoff tanks was carried out at the rate of approximately 4 p.p.m., during such times as conditions of sewage flow, or of the liquor in the tanks might have resulted in the transmission of odors to neighboring residences. It was found necessary to carry out the application of chlorine only at such times as humidity and wind conditions were adverse, this coming, primarily, during the early evening hours. Prechlorination resulted in fresh-smelling tanks and in an effluent that gave off only a pleasant chloro-substitution product odor when applied to the filters. No evidences of chlorine residual were ever noted at any point in the tanks or in the effluent. A total of 4500 pounds of liquid chlorine was used during the summer.

The average analysis of all sludge drawn indicates that it contained 94.82 per cent moisture and that 65.96 per cent of its total solids were organic in nature. The pH averaged 6.8 and the average gravity was 1.007. The sludge showed a drainability of 49.4 per cent in 24 hours. Computation indicates that the total solids removed from the tank during the drawing of the 9,702 cubic yards was 850,000 pounds, or just 425 tons.

The average efficiency of the tanks in the removal of suspended matter was excellent during the year. Monthly figures for tank efficiency indicate that removal of suspended solids varied from a maximum of 82.2 per cent in September (when the tanks were in excellent conditon and no active program of gas vent hosing was being carried on) to an exceptional low of 31.8 per cent during the trying month of April (when the advent of warm weather resulted in the belching of sludge islands up from the bottom of the sedimentation compartment). Despite these adverse conditions, efficiency computations show an average removal 66.5 per cent of the suspended solids and 59.6 per cent of the suspended albuminoid ammonia delivered to the tanks. The "theoretical tank efficiency," or the removal of settling solids, varied from a low of 44.3 per cent in April to a high of 94.0 per cent in September, and averaged 79.2 per cent for the year.

Considering the plant as a whole, the suspended solids averaged 179 in the crude sewage, 57 in the tank effluent, and 61 in the final effluent; the dissolved oxygen averaged 12.2 per cent of saturation in the tank effluent and 43.9 per cent in the final effluent; the bio-chemical oxygen demand averaged 140 in the crude sewage, 96 in the tank effluent and 25 in the final effluent.

Fly life on the sprinkling filters was controlled during the entire summer by means of artificial flood-

(*Continued on page 100*)

WERE REPEATS

SIXTY-TWO out of every one hundred orders for FWD trucks placed last year came from owners of FWD trucks. Thirty-eight per cent came from new friends. And the total demand for FWD's increased 46% over the year before!

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These statements, we believe, contain one of the biggest stories regarding what owners think of the FWD. Sixty-two per cent! You have often heard that "The proof of the pudding is in the eating." We go one better and say: "The proof of the pudding is how one feels three hours after having eaten it." Likewise with trucks. It is not how one feels when purchasing a truck, but how he feels three months or three years afterward. How does he feel after he has had the truck long enough to have tried it out to his own satisfaction as to power, speed, ease of operation. Does the truck stand up after several years of service? How many breakdowns have occurred? How many things have gone wrong for no apparent reason? Was there something to this truck's "quality you cannot see"? What kind of service does the truck give after 25,000 miles, 50,000 miles, or 100,000 miles?

• • •

No one is in a better position to find out what a truck will do than the owner who has operated it. He can't be influenced with words or pictures. No need to tell him what the truck he uses can do, *he knows.* If he isn't getting satisfaction he is going to get rid of that make of truck and look for something else. If he thinks his trucks are giving him what he has a right to expect in the way of performance and economy, he is going to order more of the same make. A customer may be "sold" the first time, but after that *he buys.*

Drive through front and rear wheels.

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Manufactured by the oldest and largest manufacturers of four wheel drive trucks in the world.

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Steer as easily as your pleasure car.

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A general service truck which adapts itself to special needs.

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Furnished in 2 to 10 ton sizes. Including six wheel and tractor trucks.

FWD TRUCKS

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You too may need FWD trucks to speed up your work and lower your costs. They will easily handle your regular work and will also take care of those emergency jobs which are too difficult for the ordinary truck.

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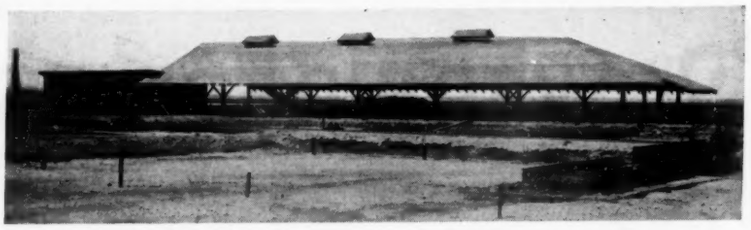


Sludge Drying, Grinding and Storage Shed of the Atlantic City Sewerage Co.

Molds Utilized to Make Sewage Sludge Inodorous

By Chester G. Wigley
Consulting Engineer, Atlantic City, N. J.

PRACTICALLY all modern sewage treatment systems include some form of tank in which the solids in sewage are decomposed in a wet or watery mass. The decomposition is accompanied by the ebullition of gas, often very offensive, and requires a long period of time.

Several years ago the writer investigated other methods of rendering sewage solids inoffensive, finally demonstrating that sewage solids in a moist condition, with practical exclusion of light and under proper temperature control, could be deodorized rapidly. The best result obtained was with a box of sludge which, because of ideal temperature conditions, was converted into a *practically inodorous* compound in 48 hours. The term "practically inodorous" is used, as after treatment the sewage solids have a musty or earthy odor.

This system of treatment for sewage solids is now being utilized in Atlantic City, N. J., for the purpose of obtaining a fertilizer base which has a ready sale at $20 per ton in ton lots. In fact, the demand at present is greater than the supply.

At the main sewer outlet in Atlantic City the sewage passes through settling tanks having a 45 minute to 30 minute detention period. The solids are removed from the hopper bottoms of these tanks by centrifugal pumps and discharged onto sludge drying beds. These solids are not more than two days older than when they first entered the sewer system in the city.

Sludge Handling

The sludge, when dried to a consistency where it can be shoveled easily, is removed and spread for further air-drying on vacant land or under sheds. It is then ground or broken up by machinery and, being still in moist condition, is stored in a dark building where molds grow throughout the material. Some form of temperature control is necessary if the process is to be continuous during winter months.

The growth of the molds affects the sewage solids in various ways. Sometimes a musty odor is found after treatment. At other times an odor resembling that of sheep manure.

The ground material appears to be an excellent fertilizer for lawns, shrubs and flowers, or as a base with which to mix other fertilizer ingredients such as potash, phosphates, etc. The average analysis of the ground material at Atlantic City, after treatment, is as follows:

	Per cent
Nitrogen	1.96
Available Nitrogen	0.76
Phosphoric Acid	0.62
Potash	0.13
Organic Material	35.9

Plans have been made and buildings are being constructed, including additional settling tanks, to increase the output of this material.

Our experience leads us to believe that the most rapid method of changing sewage solids into an inoffensive compound is by inducing a rapid growth of molds and fungi in the sewage solids.

The process described above has been patented.

Rights of Riparian Owners on Reservoir

An interesting judicial decision affecting the protection of public water supplies from pollution was rendered recently in a suit instituted by the village of Monroe, New York, against property owners on the watershed of Lake Mombasha, from which the village water supply is taken. The defendants claimed the right to use the lake for swimming, ice cutting, watering cattle, and the like, on the basis of ownership of a strip of land submerged along the shore line by the raising of the original dam.

The court held that even if defendants had title to the narrow strip of land along the shore of the lake between the present water line and the line as it existed after the five foot dam was originally finished, they would be entitled only to such riparian rights as might be enjoyed by the owner of lands under water to that extent. The defendants accordingly would not be entitled to use the lake for boating beyond the lines in question, but could use it for domestic and other riparian purposes in common with the owner of the main body of the lake, providing the waters were not polluted to any greater degree than ordinary uses would necessitate. Such rights doubtless would include swimming, bathing, cutting ice upon defendants' own lands, watering cattle and the like, but would not permit letting of the premises for boating, bathing and swimming by large numbers of people or for the construction of a great many cottages with out-buildings and toilets that would seriously pollute the waters.

Gravel Roads in Garfield County, Oklahoma

Methods of building a satisfactory low-cost road. Advantages and disadvantages

By F. W. Denner
County engineer and surveyor, Garfield County, Okla.

IN 1924 Garfield county, Oklahoma, voted a bond issue of $1,000,000 to build fifty miles of concrete and one hundred miles of gravel roads. These roads and an additional ten miles of gravel have been completed without an additional bond issue. However, Federal and State aid were received on the concrete roads, and it has been necessary to use an ad valorem levy to complete the gravel roads.

The bonds carried with a small majority, but the people who opposed them in 1924 are now wanting another issue of $250,000 for more gravel roads.

The concrete roads cross the county both ways, nearly through its center, while the gravel roads form a belt around the county and, with a few spurs, connect every town with the county seat and with every other town.

The gravel roads are built of two entirely different kinds of material. In one district a disintegrated granite, containing 17% of a greyish clay binder, was used, and in the other a hard chert or flint, containing about the same per cent of a bluish clay binder, was used. These roads were laid six inches deep, loose measurement, and in forms 18 feet wide, and were then rolled with a heavy gasoline roller. Both kinds are proving very satisfactory.

Garfield county contains no road building material, so it has been necessary to ship in all of the gravel used. The freight and hauling from the railroad track to the project has in many cases amounted to more than 75% of the total cost of the road. In order to lessen these two items as much as possible, it was determined to pay freight and hauling charges on only the metal itself, where a suitable roadside binder was available.

With this in view, a clean gravel varying in sizes from ¾ inch down was used. In the fall of 1927 six hundred tons per mile of this clean gravel was placed in the center of the road and spread to the width of 14 feet with a blade. As the road surface was very hard, the gravel could not penetrate it, and as it was loose, the traffic preferred to travel on the dirt shoulders. After the first rain, however, the traffic all started down the gravel lane and began mixing the the gravel with the clay mud. A blade kept the ruts filled and the traffic distributed over the entire surface. By the time the ground had dried, the lane had been widened to 18 feet, and a surprising amount of gravel had disappeared into the ground. After each rain, more gravel was absorbed until it was soon gone. Approximately 300 tons per mile have been added since, until now the road seems to be quite saturated, with just a little free gravel on the surface.

This method of construction did not prove satisfactory, on account of the danger to traffic caused by the loose gravel before the first rain. So the following method was used, which has proven very satisfactory. One thousand tons per mile of the same gravel was dumped along one shoulder of the road, and one inch was then bladed over the road surface. During and

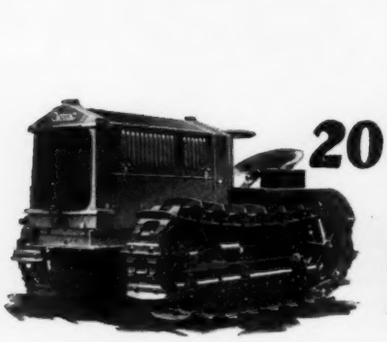
(*Continued on page 98*)

Various Uses for a Tractor

The city of Burbank, Calif., uses a recently purchased crawler tractor in a number of ways by equipping it with a pipe-handling attachment and a bulldozer. By means of the former it can not only lay sewer and water pipe in trenches, but can erect poles for carrying wires, street lamps, etc. The bulldozer is used for backfilling trenches as in the illustration. The tractor is a Model DH Trackson McCormick-Deering and the attachment is a Muskogee with a special telescoping boom made of tubing, which extends to a maximum length of 25 feet.

Burbank's Crawler Tractor Backfilling Trench

FIVE GREAT TRACTORS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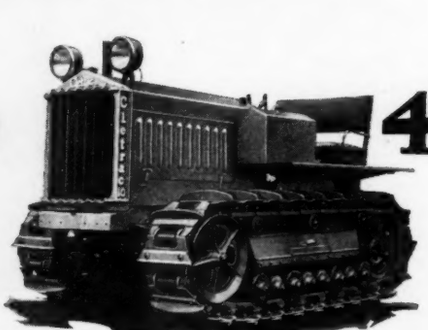
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HERE is power — cheap, dependable, profitable — to match your small jobs or your very biggest. Whether it's building new highways or maintaining old ones — excavating for a reservoir, filling in a lake front or laying out a suburb — the Cletrac line provides a choice of power units to economically meet all operating needs.

Back of these modern Cletracs is fifteen years of exclusive manufacture of "crawler type" tractors. Built into them are the many advancements and refinements that only *specialized* manufacture can develop.

Investigate these tractors — their records for speed, capacity, endurance — their unmatched economy of operation. Let us place the full story before you — or arrange with your local Cletrac distributor for demonstration.

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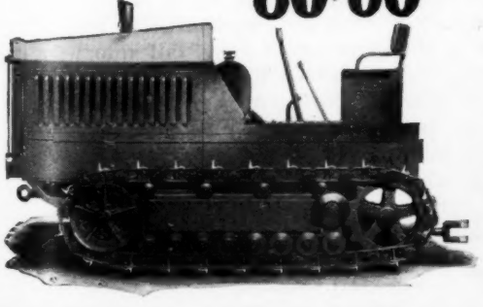

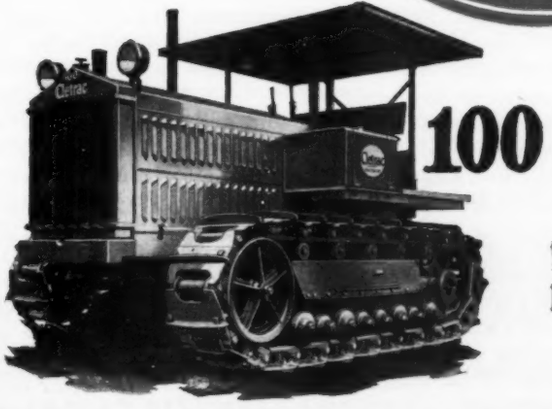

Write for Literature

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Mississippi Flood Control Work

By James C. French
Sales Manager, Monighan Mfg. Corp.

WHEN General Lytle Brown was appointed chief of engineers U. S. Army by President Hoover, succeeding General Jadwin, retired, he immediately rearranged the general control. The authority and executive agency is concentrated in the office of the chief of engineers at Washington. General T. H. Jackson, who is in charge of the Mississippi River Commission, was moved from St. Louis to Vicksburg, the commission now being an investigating, advisory and planning organization for the field construction work. Actual field construction is controlled by direction from 5 district offices. All improvement work in each district is planned, and allocated, contracted for and directed at Washington. Each district organization functions through sub-divisions known as field areas, with an area engineer in charge of all construction work in his area limits.

During the first year under this plan it was difficult to obtain a sufficient number of engineers competent to handle the work, but it is now possible to furnish experienced or semi-experienced men for all the new projects, and as the years of large contracts for levee building pass the forces will become more and more proficient and able and willing to cooperate with contractors engaged in the work.

Each district has a large quantity of equipment for levee construction, but the majority of the larger units are old and of antiquated design, no large machinery having been purchased during 1929, a fact which should be encouraging to the contractors, who are opposed to construction by government forces.

Materials for Levee Construction

The materials found available for levee construction in the different localities along the river are sand, loam and gumbo. The engineers have established cross-sections to suit each material and all projects are sectioned to suit the local conditions in each district. Any of these materials are handled easily when dry, but when wet, each presents a different problem. The gumbo is very sticky and has a tendency to form balls, giving it the name of "buckshot." Silt is very difficult to handle under any condition, especially to get it to remain stable in a levee section. It makes the softest mud conceivable and it must be mixed with other materials to insure any permanent levee structure. Sand is the easiest to handle, whether wet or dry, and does not present any problems to the contractor.

The buckshot levee is considered the best and will withstand weather erosion conditions better than any other type of construction. The sand and silt levees wash away during rains and are dangerous during high water.

It is considered that a levee should be finished station by station as the work proceeds; until a section is completed, all of the erosion and wash dangers must be carried by the contractor.

Borrow pit dimensions are definite and must be maintained to the letter of the specifications. Berms must be left accurately to dimensions. However, revision to adapt the work to the methods of construction adopted by the contractor can sometimes be made by the engineering force.

Certain definite sections have been determined upon by the engineers for each class of material or combination of materials, based upon the seepage slope as determined by experiment. The following table shows the seepage slope and levee section for each of the three kinds of material:

	Assumed seepage angle	*River slope*	*Crown ft.*	*Land slope*	*Base ft.*
Buckshot 75%	1 to 6	1 to 3	10	1 to 5	218
Loam	1 to 6½	1 to 3½	10	1 to 6	257
Sand 75%	1 to 8	1 to 5	12	1 to 7	324

The buckshot levee seems to grow stronger with age and forcibly resist erosion. New levees are especially subject to damage during construction and before acceptance, from high river water and also from being washed by heavy rains. Sodding the slopes should be completed as early as possible to check this.

Before bidding on levee work, the contractor should not only read the specifications given with the advertisement of the work but also obtain detail maps and sections from the government district offices, some of which charge for the blue prints and some do not. These, plus an inspection of the work on location and information concerning the details of weather conditions and the ground materials of the particular levee location, will give the prospective bidder and contractor all of the information necessary to prepare his bid. A certain amount of boring would be advisable for new contractors, to determine general soil conditions, plus the information that he may be able to gather from the engineer and friendly contractors who have had experience in this class of work.

Refuse Disposal at Hull, England

A refuse disposal plant was constructed last year at Hull England, replacing an old destructor, designed to handle 120 tons a day. The refuse is dumped by the collecting vehicles into a hopper, from which it is carried by a conveyor to an elevator, which lifts it and discharges it into a rotary screen. This screen has a 12-foot section with 5-16 inch perforations, a 6-foot section with 1½ inch perforations (through which cinders fall principally), and a brass section provided with electro-magnetic coils on one side which separate out tin cans and other iron and steel articles and deposit them in a chute by which they fall into a baling press. The remainder of the refuse is conveyed on a rubber belt to the firing floor of an incinerator; paper, glass, bones, etc., being picked by hand off the belt. The tailings are burned in an incinerator, heat from which creates steam in boilers, which is used to drive dynamos which operate the plant and furnish some additional current for sale.

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Sewer Systems and Plants Constructed in 1929

Review of work done during the year by the municipalities of the several states, from information furnished by state boards of health.

Delaware: Newcastle, population 4,000, put in operation sanitary sewers and 2 pumping stations, the second lifting into a c.i. outfall 1,000 ft. long into the Delaware river. About 50 per cent of the sewage is pumped from a low area into the main sewers and again into the outlet. Cost $140,000.

At Ferris Industrial School at Marshallton, small Imhoff tank, sprinkling filters, secondary settling and final chlorination, cost $10,000.

Indiana: Frankfort placed in operation a treatment plant comprising Imhoff tanks, sprinkling filters, and secondary tanks with continuous sludge removal by Hurd mechanism.

Osgood placed Imhoff tanks in operation.

Milan was building (not yet completed) Imhoff tanks, sprinkling filter with revolving distributor, and secondary settling tank with hopper.

Rochester and Rockville were each building (not yet completed) Imhoff tanks.

Maryland: At Camp Albert C. Ritchie (a National Guard camp) a sewerage system was constructed and a sewage treatment plant consisting of screen chamber, grease trap, settling tank, separate sludge digestion tank and sand filters. The sewage is chlorinated at the inlet to the settling tank. Thorough treatment was essential because the stream receiving the effluent passes close to the plant of the Rouzeville Water Company, which uses water from this stream to augment its spring supply in dry weather.

The Glenn L. Martin Co. installed at its aircraft factory on Middle river a complete sewage treatment plant for a present population of 3,000 and an ultimate population of 9,000, consisting of a primary tank, trickling filter, secondary tank, sludge digestion tank and sand filters.

The 1929 Legislature passed bills providing for sewer extensions in Frederick, Greensboro, Chestertown, Cumberland, Springfield State Hospital, Maryland House of Correction, Charlotte Hall School, Pocomoke City; and for a sewage treatment plant at Chestertown.

Michigan: Clio, population 1,300, has under construction and nearly completed a separate system of sewers, and a sewage treatment plant comprising septic tank and sand filters.

Morgan Heights Tuberculosis Sanitorium, population 200, installed a septic tank and sprinkling filter.

Petoskey, population 6,500, built a sedimentation tank and one for separate sludge digestion using Dorr equipment.

Sturgis, population 6,500, built a plant similar to Petoskey's.

Missouri: Bagnell Dam Project, sewerage system and Imhoff tank under construction.

Belton, bonds voted for sewerage system.

De Soto, sewers and separate sludge digestion plant under construction.

Eldon, Imhoff tank and trickling filters under construction.

Norborne, sewerage system and Imhoff tank under construction.

Owensville, sewerage system and Imhoff tank plans approved.

Platte City, bonds voted for sewerage system.

Troy, sewerage system and Imhoff tank completed.

Vandalia, activated sludge plant completed.

Warsaw, bonds voted for sewerage system.

Wellsville, sewerage system and Imhoff tank under construction.

The above do not include extensions of sewerage systems.

North Dakota: Beulah built a sewerage system and septic tank costing $23,500.

Hebron built a sewerage system and septic tank costing $30,000.

Walhalla built a sewerage system costing $25,000.

Oklahoma: Sewer system, Imhoff tank and sludge bed were built by the following: Allen, costing $38,000; Asher, costing $28,000; Binger, costing $25,000; Cement, costing $27,500; Davidson, costing $23,000; Hammon, costing $25,000; Leedey, costing $28,000; Meeker, costing $23,981; Quinton, costing $48,000; and Thomas, costing $42,000.

Sewer system, Imhoff tank, dosing chamber, sprinkling filter and sludge bed were built by Blair, costing $27,000; Gotebo, costing $40,000; Granite, costing $45,000; Hydro, costing $28,000; and Minco, costing $39,000. Texhoma built these and also installed a chlorinator, costing $58,425.

Edmond built the same kind of treatment plant, but no sewers, costing $25,000.

Frederick built an activated sludge plant using Simplex equipment and chlorination, costing $31,560.

Hooker built a sewer system and activated sludge plant using Simplex equipment and chlorination, costing $102,605.

Claremore built an outfall sewer and reconstructed its Imhoff tank at a cost of $53,940.

Yukon built an Imhoff tank, dosing chamber and sludge bed and reconstructed contact beds into a sprinkling filter.

Mississippi: New sewerage systems were built by Goodman, Terry, Newton, Fulton, Houston, Port Gibson and McComb.

Terry, Fulton and Houston built plain septic tanks. Newton installed plain septic tanks and pre-chlorination for odor control. The McComb plant consists of Imhoff tanks and trickling filters, with pre-chlorination for odor control.

The Masonite Corporation, at Laurel, installed, for disposing of its waste, a Butcher clarifier—recirculation of clear liquor and ponding of sludge.

Rhode Island: East Greenwich installed plant of 120,000 gals. per day capacity to protect shellfish

(*Continued on page 86*)

Sewage Treatment at State Institutions

Opinions of several state sanitary engineers on the suggestion, made in our March issue, that such plants serve as models and be used for experimental purposes.

IN the March issue of PUBLIC WORKS we suggested editorially the advisability of making sewage treatment plants at state institutions models of their kind in design and operation, for the instruction and encouragement of operators of other plants in the state, and also of using some of them as experimental plants. In most states this would probably require such changes as would give the state health board control over the design, construction and operation of such plants, and increased appropriations to either the board or the institutions.

We have asked the sanitary engineers of the several state health boards to comment upon this idea and inform us to what extent it has been carried out in their respective states. Replies have been received from eighteen at this date.

The writing of the editorial was suggested by reading the annual report of the Bureau of Sanitary Engineering of the Maryland State Department of Health, extracts from which were given in our April issue. As stated therein, the bureau has assumed direct supervision of water and sewage treatment plants at nine state institutions and an engineer of the bureau devotes his full time to the work, the cost of this being met by contributions by the institutions of $250 to $600 each per year. Abel Wolman, the chief engineer of the board, states that they have not made any structural modifications for experimental purposes, and that our suggestion that the cost of such might be kept low by using inmate labor is not supported by their experience, which is that "low cost is more than offset by lower efficiency." But the "suggestion is an important one and certainly can be realized, as it has been in Maryland, with reference to experimental modifications in many of the details of operation."

H. A. Whittaker, director of the Division of Sanitation, Minnesota Department of Health, says that "for a number of years we have used the sewage treatment plants at certain state and county institutions for experimental purposes, although we do not have any definite authority granted to us by the state legislature to so use them," but this has been done through special arrangements with the State Board of Control and the management of the institutions.

"The State Board of Health of Montana has to a very limited extent used this method," says H. B. Foote, director of the Division of Water and Sewage, "and we think that it is a good method and one which gives a satisfactory scheme of experimentation."

In Texas, says V. M. Ehlers, chief sanitary engineer of the State Dept. of Health, "we have designed plans for several state institutions that are model sewage disposal plants, but unfortunately they are not always maintained and operated in the best manner. We have been working along the lines suggested in your editorial . . . and have succeeded so far in establishing a sewage experiment station at Texas A. & M. College."

In Kansas Earnest Boyce, director and chief engineer of the Division of Water & Sewage, State Board of Health, last year directed the installation of a plant at the Federal Indian School designed with the very definite idea that it would be available for investigational work by the Board of Health and instructional use in connection with the teaching of sanitary engineering at the University of Kansas, in which the personnel of the Division of Sanitation of the Board of Health gives the instruction in this subject. The plant consists of an Imhoff tank, two Simplex units and a Dortmond type tank, with very flexible by-pass arrangements for modifying the operation. "We believe that a great deal of good could result from the use of state-owned plants in the way suggested by your editorial, provided these plants are within reasonable distance of the department offices."

No other states from which replies have been received have carried out such ideas, although all but one approved of the idea of "model" plants, and most of them that of experimental plants also. The apparent exception is Dr. James Stewart, State health commissioner of Missouri, at whose direction public health engineer W. Scott Johnson writes that "The question naturally arises whether or not a division of sanitary engineering should spend the time in research work unless all other phases of sanitation work within the state are being taken care of in a satisfactory manner. . . . In those states where there are more than enough personnel and finances to adequately handle all matters of sanitation, it would seem that research work by the division of sanitary engineering would be desirable and productive of valuable information. In Missouri we have only one institutional plant of modern design and we have to date only been able to give this plant the same routine attention as regards operation that is afforded municipal sewage treatment plants in the state. . . . In general, institutional sewage is quite different from the average domestic sewage, and consequently study on full-size institutional sewage treatment plants might be of rather limited value as regards its application to the larger problem of sewage treatment for a municipality."

"I do not wish to infer from the above that it is not desirable that sewage treatment plants for institutions should not be of excellent design and efficiently operated. However, I do believe that money available for health work is in most cases entirely too limited at present and certainly we should guard against its use for other purposes than those which will pro-

duce the maximum health benefit to the people of the state."

While the health officials of the other states approve of the idea, most of them think it is not practicable in their own states, the majority of them either because the legislature will not furnish the necessary funds, or because the board of health has not sufficient control over such plants and the officials of the state institutions take no interest in them. One state reports such officials as wishing the easiest thing to operate that will produce the lowest grade effluent that will be allowed.

In Michigan the Engineering Bureau of the Dept. of Health designs and constructs the sewage treatment plants for state institutions, and has the same control over operation as in the case of municipal plants. It depends largely on the superintendent of the institution how much money is secured in the budget for maintenance, says Edward D. Rich, director, Dept. of Health, but "we believe that if a complete new plant is built and put into first-class running order, and particularly if the plant is beautified by the addition of shrubs, flowers and lawns, the superintendent is more likely to be proud of it and insist on enough money to pay for adequate maintenance and operation."

The possibilities of the idea are well and concisely stated by A. H. Wieters, chief engineer of the Iowa Department of Health, as follows: "The plants could at once be designed to take care of the sewage from the institution in question and at the same time certain experimental features could be incorporated which would give an opportunity of studying certain features of operation that are not well understood and information on which cannot be readily obtained from the ordinary plant. Such experimental features could be included in the original design with very little additional cost, and I believe that such small additional cost would be justified. In these plants I would not advocate any radical departure from standard practice, but I believe the state would be justified in deviating from such standard practice in matters concerning which there are some theories that have not been definitely proven in actual practice. The supervision of the operation of these plants should, of course, logically come under the sanitary engineering division."

Items of Interest to Sanitary Engineers

Treatment of sewage and waste waters. Sewer rental. Refuse disposal. Stream pollution. Washing filters.

Treating Dairy Wastes on Trickling Filters

Studies at the Texas Engineering Experiment Station on the treatment of dairy wastes, by E. W. Steel and P. J. A. Zeller resulted in the following conclusions:

1. Wherever possible a trickling filter rather than chemical methods should be used to treat dairy wastes. The advantages of the former method are as follows:
   (a) No preliminary treatment is needed except grit removal.
   (b) Sludge and scum disposal is not a problem.
   (c) A better effluent is obtained.
   (d) Slight treatment can be given to prepare the waste for discharge into city sewers.
   (e) A filter is more adaptable to fluctuations in the strength of the waste than is the chemical method.
   (f) Skilled operation is not required.
   (g) Operating cost will be low.

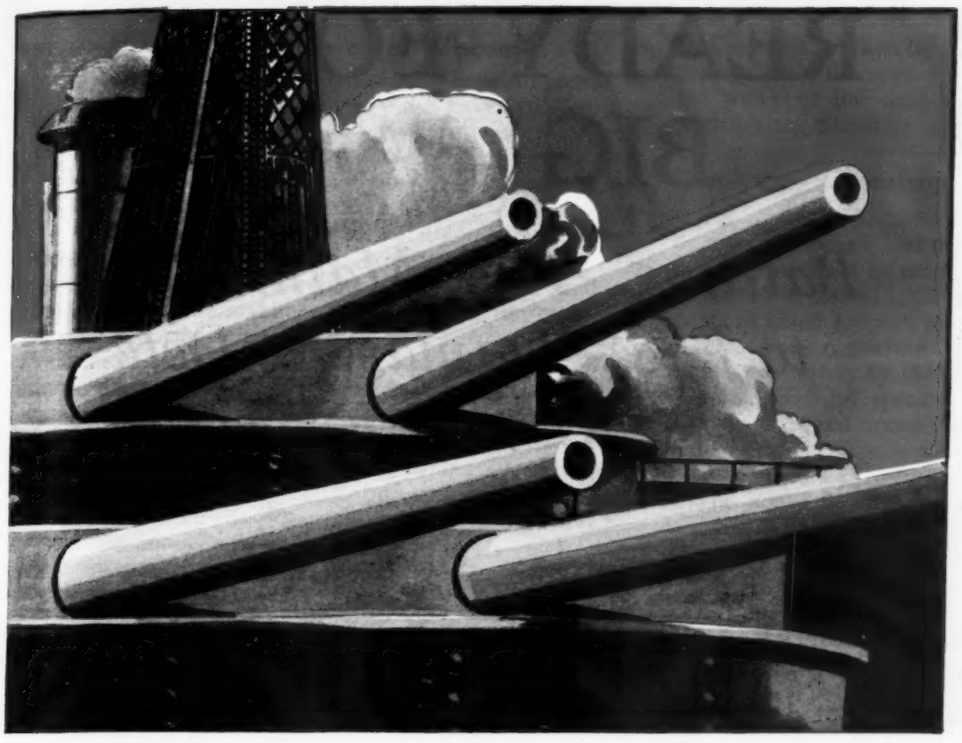
2. A trickling filter 5 feet deep operating at a 1.5 million gallon per acre per day rate or a filter 6 feet deep operating at a 2 million gallon rate will produce a satisfactory effluent in the treatment of ordinary dairy waste (not including whey from cheese factories). At the 1.5 gallon rate, a filter 3 feet deep will give sufficient treatment for some purposes. (Note: These rates are based upon 24 hour operation per day. If the waste is discharged during 12 hours only the area-dosage relationship must be changed accordingly).

3. Sulphuric acid, alum, ferric chloride, and ferrous sulphate are of value (approximately in the order named) in precipitating milk solids. With proper operation this method should produce an effluent suitable for discharging into streams or upon land without nuisance and without the necessity of chlorination. Sludge and scum will be a troublesome by-product, although that resulting from the sulphuric acid treatment could probably be used for feeding to hogs or chickens.

Treatment of Dairy Wastes

In a paper before the New York State Sewage Works C. L. Walker estimated the average volume of milk product waste in New York state at about 1,000,000 gallons daily, with a maximum of about 3,000,000 during the peak of May, June, July and August. The strength of the waste depends primarily upon the amount of buttermilk and whey contained therein, and under certain conditions is ten times as strong as the average for domestic sewage.

Treatment was discussed under the heading of "Weak Waste" and "Concentrated Dairy Waste." Reference was made to literature covering previous investigations which have brought out that Imhoff tanks are satisfactory but that septic tanks with 24 to 72 hours' detention followed by sand or trickling filters effect a purification of 80 to 98 per cent based upon the organic nitrogen. Sand filters were operated at rates from 50,000 to 75,000 gallons per acre per day and trickling filters, 500,000 to 2,000,000 gallons per acre per day. Later experiments at Iowa and Wisconsin by tank treatment were omitted. It is stated that little has been done in the treatment of concentrated wastes, but recovery or utilization as hog food or by drying offers the best solution. Experiments in chemical treatment of concentrated wastes were carried on at two New York state plants during the past summer.



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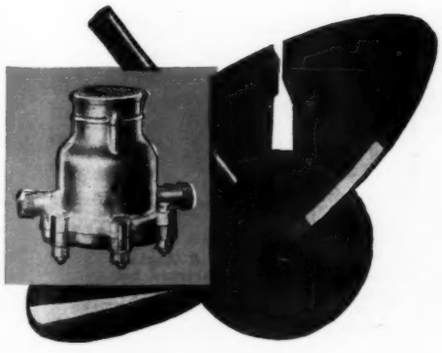

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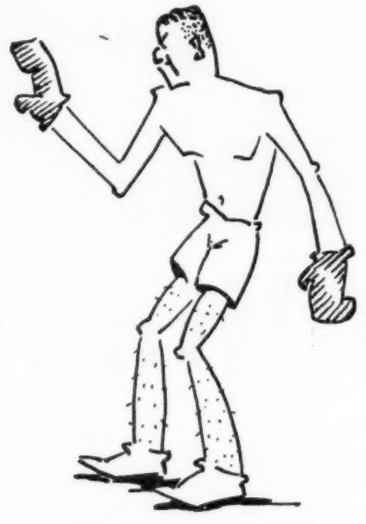

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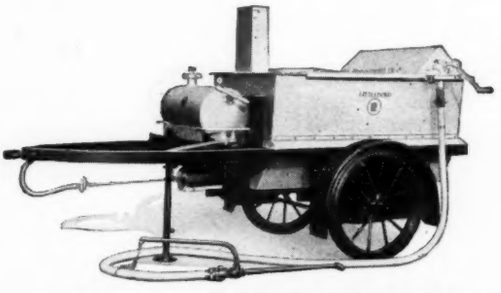

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Rental for Sewers in Wisconsin

During 1929 the legislature of Wisconsin passed an act permitting municipalities which have installed sewage treatment or disposal plants approved by the state board of health to collect rental charges from the owners of property served directly or indirectly by the plant; the income therefrom to be spent for the operation, maintenance and repair of the municipal sewerage system and sewage treatment works.

The rental charges must be "reasonable" and for the purpose of making them equitable, the properties benefited "may" be classified on the basis of "volume and character of the sewage or waste and the nature of the use made of such sewerage facilities." The rents are collected in the same manner as water rates. Any 25 or more freeholders may complain to the railroad commission (corresponding to a public service commission) if they think the charges are unreasonable or discriminating; and it, after public hearings, may order the municipality to change the rates.

Methane Gas from Corn Stalks and Sewage

By combining ordinary sewage with corn stalks in a simple process, University of Illinois chemists are recovering large quantities of methane gas which can be used for heating, for operating motors, and for driving engines producing electricity, according to an announcement made at the American Chemical Society's 78th meeting held recently in Minneapolis. Dr. A. M. Buswell, professor of sanitary chemistry at Illinois, assisted by C. S. Boruff, discovered the process.

Bacteria from sewage acting on the cellulose in the corn stalks creates the gas. The University of Illinois has recently applied for patents on the process.

Covered Sludge Beds at Toledo

In designing the new Bay View sewage treatment plant for the city of Toledo, Ohio, the consulting engineer, H. P. Jones and Company, adopted the plan of covering the sludge beds with glass to facilitate and aid in the drying. Also they have adopted the down draft system of controlled ventilation, as described in PUBLIC WORKS for January 1930; a development of research conducted by engineers of the Barns Engineering Company, which is to construct the glass enclosures for the drying bed.

The sludge drying beds will be 153,000 square feet in area, divided into four units each 162 ft. by 242 ft. in plan. The dried sludge will be removed from the beds in narrow-gauge cars drawn by gasoline locomotives.

Wash Water Compresses Air for Washing Filters

The new Kempton Park works of the London, England, water supply includes twenty-four 2-m.g.d. rapid sand filters arranged for combined air and water washing, the former secured without the installation of mechanically driven air compressors or blowers by discharging the wash water from the elevated tank into one of two seven-foot diameter steel cylinders, thus compressing the air in it, displacing it and forcing it through the filter beds. This necessitated building the wash-water tank 24 feet higher, but the resultant saving in capital cost of machinery will outweigh this expense. When the air is expelled from the compressor tank, the supply of water to it is shut off and the water in the compressor tank then is used for washing the filters.

Solving the Garbage Problem in Alton, Ill.

The private random collection and indiscriminate dumping of refuse and garbage in this city of 35,000 has been replaced by municipal collection and disposal, estimated to cost $15,000 per year, or a saving to residents of about $35,000 per year. Garbage, ashes, and refuse, from residences only, are kept separate and hauled separately by the contractor, in five trucks conforming to rigid specifications, to a central isolated dumping ground under the supervision of a caretaker until an incinerator is available. Ashes and cans are used in making fills of poor streets and sink holes.

The above is from an article by Thomas Butler, which appeared in The Illinois Municipal Review, and which was prepared for Public Health Engineering Abstracts by A. W. Fuchs.

Refuse Disposal in Fort Smith

Fort Smith, Ark., under an ordinance passed in 1925, has a simple but effective system of collection and disposal of garbage. Garbage and rubbish are combined. Collection in the business, or fire, district is made daily; in the residence districts, weekly. The collection in residence districts is free, while in the business section fees are charged ranging from 50 cents to $6 per month according to the type, size, and purpose of the building. The daily collection in the business district is made by two dump-body trucks. In the residence district 11 wagons are used. After wagons have been loaded, the horses are unhitched and two or three wagons are linked together and drawn by a truck to the incinerator, where the combined refuse is burned. No salvage is attempted.

Stream Pollution in Michigan

The Department of Health of Michigan is endeavoring to arouse a public sentiment in favor of reducing pollution of the streams of the state. It states that, of 96 communities which should treat its sewage, only 38 have treatment plants, these 38 containing 10 per cent of the entire population of the state. The sewage of 68 per cent of the population is discharged untreated into streams and lakes.

Additional pollution of streams is caused by 322 major industries. The state has a stream control commission consisting of the heads of the Departments of Health, Conservation, Agriculture and Highways, and the Attorney General. The state laws provide for financing sewage treatment plants.

Pollution of English Rivers

A recent issue of an English periodical, "Fishing Gazette," states that, of 81 rivers in England and Wales, 45 are badly polluted, 21 slightly polluted, 2 were classed as doubtful and 13 as not polluted. It is urged that the protection of the rivers be entrusted not to local authorities, but to river boards constituted for the sole purpose of protecting one or more rivers from source to mouth; a method claimed to have succeeded at small cost in Yorkshire and Lancashire.

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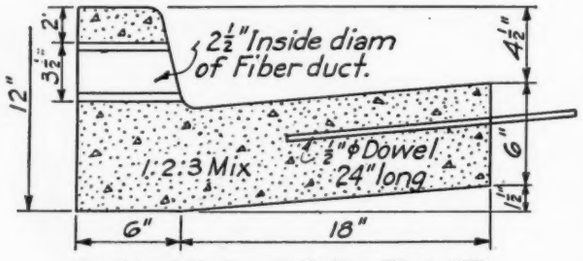
Curb and Gutter in West Allis

Some years ago at West Allis, Wisconsin, integral curb was a standard design, but during the past few years combined curb and gutter has been the standard. The city has also changed from the two-course construction originally called for to a one-course construction. During the past four years the city has used half-inch round bars 24 inches long spaced 18-inch centers, to dowel the gutter to the pavement base. In general, the position of the bars is varied according to soil conditions. When sandy or average soils are encountered the dowels are placed at about the center or neutral axis, while where clay is encountered it is found desirable to place the dowels near the top of the gutter section.

To provide for drainage from the surface and roofs of abutting property, openings are provided in the curb, for which purpose fiber ducts of 2½-inch inside diameter are inserted in the curb at intervals not exceeding 30 foot centers.



Combined Curb and Gutter, West Allis

At street intersections a radius of 15 feet for the face of the curb is employed, while for alleys or a driveway 4 feet is used. To provide for expansion and contraction, a half-inch space is left every five feet around all radius curbs, which space is later filled with a mastic filler.

As the combined curb and gutter is doweled to the pavement foundation, expansion joints in the curb and gutter section are spaced at 30-foot intervals, coinciding with the joints of the pavement slab, and are made the same width, one-half inch.

Sewage Treatment in California

Some interesting features of sewage disposal as practiced by certain California municipalities are described in the California Sewage Works Journal. F. H. Froehde tells how Pomona obtains an income of $9,624 to offset part of the cost of disposing of its sewage. The effluent from the activated sludge plant is sold, under a 20-year contract, to the Northside Water Co. of Walnut, which sells it for irrigating purposes, paying the city one-half cent per inch-hour from October to April, and one cent per inch-hour for the remaining six months. For this the revenue last year was $4,669. The sludge is sold for $414. Water from a paper mill is sold for $1,652. Pomona charges two small cities $1,389 for treating their sewage; and it leases the sewer farm for $1,500.

Fresno for sixteen years prior to 1924 discharged its sewage, after settling in a septic tank, onto 812 acres of sandy loam eight miles from the city. No attempt was made to drain away the water and as a result the sewage raised the natural ground water level considerably in the vicinity. To remedy this, a number of 16-inch deep wells were sunk into water-bearing sand at various parts of the farm and water pumped from them and delivered in ditches to an irrigation district. By this means the ground water level has been lowered from 5 to 9 inches.

Long Beach has maintained a sewage pumping plant alongside a large apartment house in a residential district. Herbert Patterson, in describing the plant, said that, to prevent odor, the sewage should reach the pumping station after not more than three-quarters of an hour in the sewer; the wet well should be vented with at least an 8-inch pipe to a manhole and be lined with vitrified clay plates set with asphalt joints. He had found the most satisfactory pump to be the horizontal centrifugal with two-part impeller.

Sweeping Change Method of Street Lamp Replacement

In an address before the Ontario Municipal Electrical Association, Kirk M. Reid, director of street lighting and flood lighting, General Electric Co., described as follows this method, which he said was coming into considerable practice in the United States:

"Under this method there are two different subheadings. Some of the central stations segregate the city into different districts; keep a record of the total lamp failures per night, or per week, in each of these districts and, when the rate of failure exceeds a certain figure, they go through that whole district and remove all the lamps, putting in new lamps. The other plan is merely to keep track of the burned hours and, when the burned hours have reached an average rate—the life of the lamps or a little bit over—they go through and remove all the lamps.

This has certain advantages. By so doing you undoubtedly remove from the circuit a great many lamps that are about to fail, and I think you will agree that, where a lamp costs us $3.00, when it has a few hours life left in it—ten per cent we will say—it is worth only 30c; and it is usually far cheaper to sacrifice some thirty cents' worth of life, than to make a special trip to replace that lamp when it burns out 50 or 100 hours later.

By this method of the sweeping change, the cost per lamp on replacement is very, very markedly reduced, and the unexpected outages have been brought down to a fraction of one lamp per year, which means that it is possible to retrench very markedly on the cost of patrolling, which you men may or may not employ; but patrolling is, of course, what would be regarded as an unproductive expense. It doesn't directly result in the production of any more light and putting it down on the street, so if there is any system whereby that can be reduced it is a step towards the ultimate economy.

Each lamp that is taken out in this sweeping change method is examined, and if it shows a blackened bulb or a sagged or pitted filament, and that it is about at the end of its life, it is broken up. About a quarter of those that show they still have considerable useful life in them are saved and re-used for replacements of the occasional burnouts that occur in the new batch of lamps."

Reducing Fire Hazard on California Roads*

More than seventy-six thousand dollars to be spent in clearing the sides of more than a thousand miles of state roads.

By T. H. Dennis
Maintenance Engineer, California Div. of Highways

A FIRE hazard reduction program was initiated by the Californa Division of Highways early in 1928 by B. B. Meek, director of the Department of Public Works. Prior to that time fire reduction along state highways was more or less incidental to the roadside grading.

Initiation of the work was prompted by a keen appreciation of the potential menace that matured vegetation bordering the highways offered adjoining property, as well as the difficulty of fixing responsibility for roadside conflagrations caused by careless users of the roads.

During 1928 some 660 miles of highway roadside were cleared at a cost of $37,850. The largest single operation consisted of clearing 29 miles of 80-foot right of way on the southerly portion of the Ridge Route.

The 1929 program involved an expenditure of $54,000 on 885 miles of roadside. This year's program now under way has been extended somewhat and will involve the clearing of 1020 miles of roadway at a cost of $76,750.

In the main this work has been confined to locations where the highways are bordered by grain, grazing, or heavy brush areas. Various methods of eradication have been tried out. These included cultivation, mowing, spraying with oils and chemicals, and burning. Of these methods of control, burning has been most effective, though considerable risk attends the work, particularly when the adjacent fields are dry and inflammable. This risk has been overcome to a large extent by our present practice of spraying the roadsides early in the spring with 27°+ gravity Diesel oil.

The spraying last year was handled by five state-owned and four rented outfits. Each unit consisted of a 3½-ton truck, carrying a 1,000-gallon tank. At the rear a platform supported a number 2 Trahern spiral gear centrifugal pump, powered by a 1½ h. p. engine. The oil was pumped through a ¾-inch hose, which supplied five orchard-type sprays set in a 6-foot section of ¾-inch steel tubing. Oil was applied at a rate of from 1/10 to 1/6 gallon per square yard of surface treated.

The oil spray imparts a brownish-green color to the roadsides, and within a week's time the growth has withered and dried to the stage where it can be burned readily. This method, however, is too expensive for general application, as the cost per mile of treating a 9-foot area both sides of the roadway, exclusive of burning, is $70 to $115, respectively, for the 1/10 or 1/6 gallon application. This cost is based on Diesel oil at 4 cents per gallon, and its application at 2½ cents per gallon. Due to this high cost, we limited the treatment last year to a 4½-foot area adjacent the fence lines, where the growth is heavy and particularly difficult to eradicate except by burning. This strip usually served as an effective fire break for the burning performed after the roadside growth was matured and dried up.

The progress was necessarily slow, as the spray was hand directed, and application thus limited to walking speed. The weight of the spray and hose imposed a considerable burden on the operator. During the past winter our Headquarters Equipment Department redesigned the spraying unit, resulting in greater progress and ease of application. This outfit consists of a trailer unit to be attached to a tank truck. This trailer carries the pump unit, together with a telescopic outrigger arm, which supports a ½-inch rubber hose. The outlet end of the hose is attached to a 9-foot spray bar. The operator stands on a platform on the trailer and easily controls the position of the outrigger and raises or lowers the spray bar as required. A similar outrigger arrangement has been built for installation on the regular heavy oil spreader trailer units, and it is expected these units will give greater volume per day because of the greater pump capacity. Our best progress in light hours with this unit is two 9-foot strips along 8 miles of roadway.

Portions of the work last year were contracted to carry our peak load, but the results were not entirely satisfactory. The contractor was interested mainly in the amount of oil spread, and made little effort to avoid spraying trees, shrubs, or even guard rails, which greatly increased the subsequent burning costs. We favor doing the work by contract, providing we can safeguard against such promiscuous spraying.

Burning costs have averaged between $20 and $30 per mile, depending on the amount of protective measures required. Considerable care is necessary in this phase of the work, as a slight change in wind might easily blanket the highways with smoke, causing a grave hazard to traffic. To guard against this contingency our men are instructed to control all traffic through the burning zone.

They are also instructed to secure the consent and aid of the owner before burning in front of his property. If this is refused, no burning is done, as we feel the work is primarily for the owner's benefit, and our men should not be obligated to assume his responsibility. In general, we do not expect to carry on this work after April 1.

This year we are carrying on extensive experiments with a nonpoisonous agent which is sprayed on the roadsides similar to the Diesel oil. The killing action is very similar to that of the oil, though it is claimed the burning is unnecessary, as the growth shrivels up and disappears. Claims are also made that after sev-

*Slightly condensed from article in "California Highways and Public Works."

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eral yearly applications the ground becomes sterile and future growth is eliminated. Needless to say, we are very much interested in having this prove a success, as it eliminates burning, which greatly disfigures the roadsides.

The result of this work the past two years have been very encouraging; few, if any, preventable fires starting along our highways. In this part of our work we have had the hearty cooperation of the Department of Natural Resources, Bureau of Forestry; also of several county organizations which had equipment available.

While this phase of hazard reduction is of partcular interest to the grower and cattleman, there is yet another which presents a problem of state-wide interest—the protection of our state and national forests.

Early in 1924 a cooperative agreement was concluded with the U. S. Department of Agriculture, Forest Service, whereby the Division of Highways' employees were pledged to report and handle all fires adjacent to our highways within national forests, pending their relief by the proper forest official with adequate forces. In the case of fires for which our employees were not responsible, the agreement provided for reimbursement of the state at the going fire fighting rates for labor and equipment.

A similar agreement affecting areas adjacent to state highways within the state forests was also concluded this year between the Division of Highways and the Department of Natural Resources, Bureau of Forestry, on request of State Forester M. B. Pratt.

These two agreements we are assured are very beneficial, as assistance is provided at the most critical period.

In addition to this cooperation, we have during the past two years been carrying on an active clean-up program within our rights of way through forested areas. This work must of necessity spread out over a period of years, due to the extensive territory involved. The importance of this work has been recognized, and special provisions concerning clearing have been written in all construction contracts within forest areas.

How About Gasoline Shovels?

A contractor reports the receipt of the following letter from an indignant citizen who lived nearby:

"Why is it that your steam shovel has to ding and dong and fizz and spit and bang and hiss and pant and grate and grind and puff and chug and hoot and toot and whistle and wheeze and jar and jerk and howl and snarl and groan and thump and boom and smash and jolt and screech and snort and slam and throb and roar and rattle and yell and smoke and smell and shriek and fume and crash all day long?"

This would seem to be a rather difficult question to answer offhand.—*Iowa Engineer.*

Mechanical Finishing of Indianapolis Pavements

Indianapolis now requires that all its concrete pavements be struck off and consolidated by a finishing machine such as is used in road work. As it does not seem practicable to finish with such a machine all the way to the curb, where the curbs have already been constructed, a side form is set two or three feet in from each curb and the finishing machine runs on these, just as it does on highway work. The two or three feet between this strip of concrete and each curb is then filled in and finished by hand. A tongue-and-groove joint is made between the main central strip and the narrow side strips by bolting or welding to the inside face of the steel form a deformed plate which produces a groove in the side of the main slab.

Before placing the concrete, the subgrade is checked with a scratch template attached to the mixer and sliding along the side forms. A minimum compressive strength of 3500 lbs. is required, and the mix is ordinarily 1-2-3½.

Census of the Construction Industry

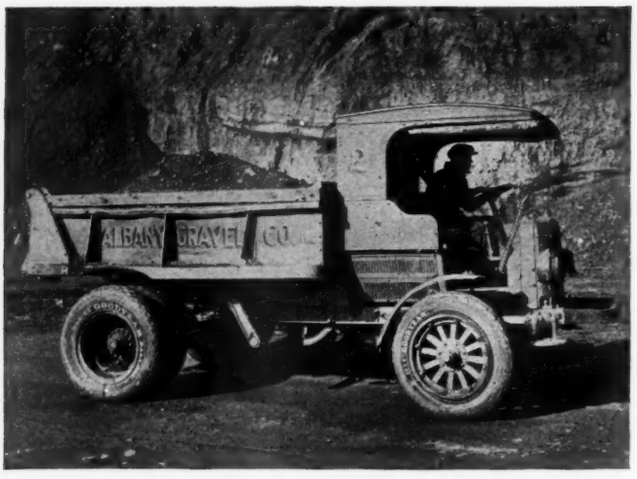
The first census of the Construction Industry ever undertaken by the United States Government is now on the way as part of the 1930 decennial Census. Contractors have urged this as a means of promoting efficiency in the conduct of the construction industry.

Information is being collected concerning the number and kind of general contractors, sub-contractors and operative builders throughout the United States and the total value of work performed by them in the various states and cities during 1929. General contractors will classify themselves as building, highway, grading, waterworks, dredging, railroad, and other contractors. Sub-contractors will indicate whether they are engaged in carpentering, concreting, heating and piping work, electrical work, masonry, plastering, sheet metal work, marble and tiling work, or other trade.

Questions regarding the number of skilled and unskilled workmen on the pay rolls, and the total annual pay roll, will have a direct bearing on the matter of employment in this industry and will indicate the seasonal character of construction work of various kinds. The trend toward rental rather than the ownership of construction equipment in the endeavor for greater efficiency and lower unit costs will also be disclosed; as well as the various items of expense, such as rent, liability insurance, bond premiums, and all other overhead expenses.

Pre-qualification in Philadelphia

As told in our February issue, a Philadelphia ordinance providing for pre-qualification of bidders was declared illegal by the Court of Common Pleas, from which decision the city appealed. The Supreme Court of Pennsylvania last month ruled that the City Council had the right to pass a legal ordinance which would "provide for the determination of the question of who are responsible bidders on municipal work before the receipt of bids." It ruled, however, that the present ordinance was invalid, but pointed out that if the ordinance had been passed in accordance with the recommendations of the Citizens' Contract Committee providing that all questionnaires and answers received in connection with pre-qualification be referred to a committee of three consisting of a member of the city solicitor's office, the controller and the department affected, instead of placing the whole authority in the hands of one official, it would have been legal and valid. "Not otherwise under this plan can all prospective bidders be placed on the same plane, which is an essential requirement." It is understood that the city will immediately enact a new and legal ordinance in line with the court's decision.



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THE EDITOR'S PAGE

County Highway Expenditures in 1930 Will Exceed Those of 1929 by 10 Per Cent

In our March issue we presented figures in support of our belief that municipal expenditures for public works this year will total twenty-five per cent greater than last. In this issue we give our reasons, in the form of figures from a quarter of all the counties of the country, for thinking that from five to fifteen per cent more money will be spent on highways by counties this year than last.

As a check on the reliability of the figures on which we base this estimate, we compared the estimates made a year ago for 1929, with the amounts actually spent that year by the same counties, and were surprised to find that the totals differed by less than one per cent. In very few counties were the expenditures identical with the estimates, some running over and some under; but the optimists and pessimists apparently just balanced. This year it seems probable that, considering the estimates were made in March or early April, there was a prevalence of pessimism which latest reports indicate was unduly exaggerated. Therefore the conclusion from the reports made by our six hundred correspondents, that there will be an increase of 6½ per cent over last year's expenditures, may possibly understate the increase, which may reach fifteen per cent or even more.

Certainly we are justified in believing that, unless something unforeseen happens such as difficulty to sell county bonds, this year's expenditures by counties on their highways will exceed those of last year.

High Standard of County Highway Engineering

Thirteen years ago, when we began the annual collection of county highway statistics, less than twenty per cent of the counties were constructing any pavement of a higher class than gravel. More important still was the character of the work done and of the men who did it. The answers to our questionnaires revealed a grade of intelligence that was disheartening. Inquiry as to what conditions called for repairs and what for reconstruction, and what official had charge of county road work, brought this reply from Connecticut:

Gen and Sir

If a New road is Build after 2 Yearz; Neet Know repairing soch a road mus be So az we Cant see no Weele Mark them road they not Build in Conn. we hatt only one Mann his name was J. H. McDonald he know I Build a road for him Som Blasess have 6 ft. filling—

While this was not typical, there were plenty nearly as bad. Some county engineers measured up to a high standard of ability and intelligence, but they were relatively few.

The change in the past decade has been remarkable. Now half a billion dollars is being spent annually by educated county engineers, whose ability and intelligence is indicated by the many excellent articles they contribute to PUBLIC WORKS, the high class of road construction and maintenance work they perform, and the salaries they are able to command—and that they earn; and with the increasing attention being paid to low-cost roads, the county roads are assuming a new importance.

Truly, county highway engineering is reaching a position of importance and excellence second to none.

Why Cities Employ Consulting Engineers

"The work of a city engineer, with all the detail connected with street grades, paving, minor sewer and water improvements and the maintenance and operation of the city's interests, is general in its nature and requires the full attention of the average engineering department. When major projects arise in sewage and garbage disposal, water supply or water purification, they require specialized engineering knowledge. Because these special problems occur infrequently in a single city, it is more economical and expeditious for a city to employ consulting engineers who specialize in this class of engineering projects."

Howard Cozzens, city engineer of Salinas, Calif., thus states briefly the reason why most cities employ consulting engineers and why more should do so. No one man can be a reliable specialist in more than one branch, or at most two or three related branches, of engineering; and a city engineer should not be expected by his fellow officials to be an exception. It is not a confession of lack of ability on his part to ask for the employment of a specialist to help him in solving special problems that may arise; rather it helps to convince the citizens of the important part engineering science plays in giving them the utilities and conveniences which they accept as commonplace features of community life.

Mr. Cozzens gives a reason for another practice which is not always so defensible—what is often referred to as "junketing trips." In describing the procedure of obtaining a sewage treatment plant for Salinas he said: "In order that the city officials might familiarize themselves with sewage treatment problems and methods, they made an inspection trip to several sewage treatment plants in central California and conferred with other city officials and with the engineers of the State Board of Health."

It is difficult, in many cases, to get the taxpayers to vote for a sewage treatment plant; but education of them in the reasons for and methods of treatment will do much toward developing a favorable popular feeling, and this education may well begin with the city officials. In the case of Salinas, the officials, having informed themselves, passed on the information to the citizens by means of newspaper interviews, talks before civic groups, etc., and the vote for a $350,000 bond issue was carried ten to one. The expense of the officials' inspection trip was certainly justified in this case.

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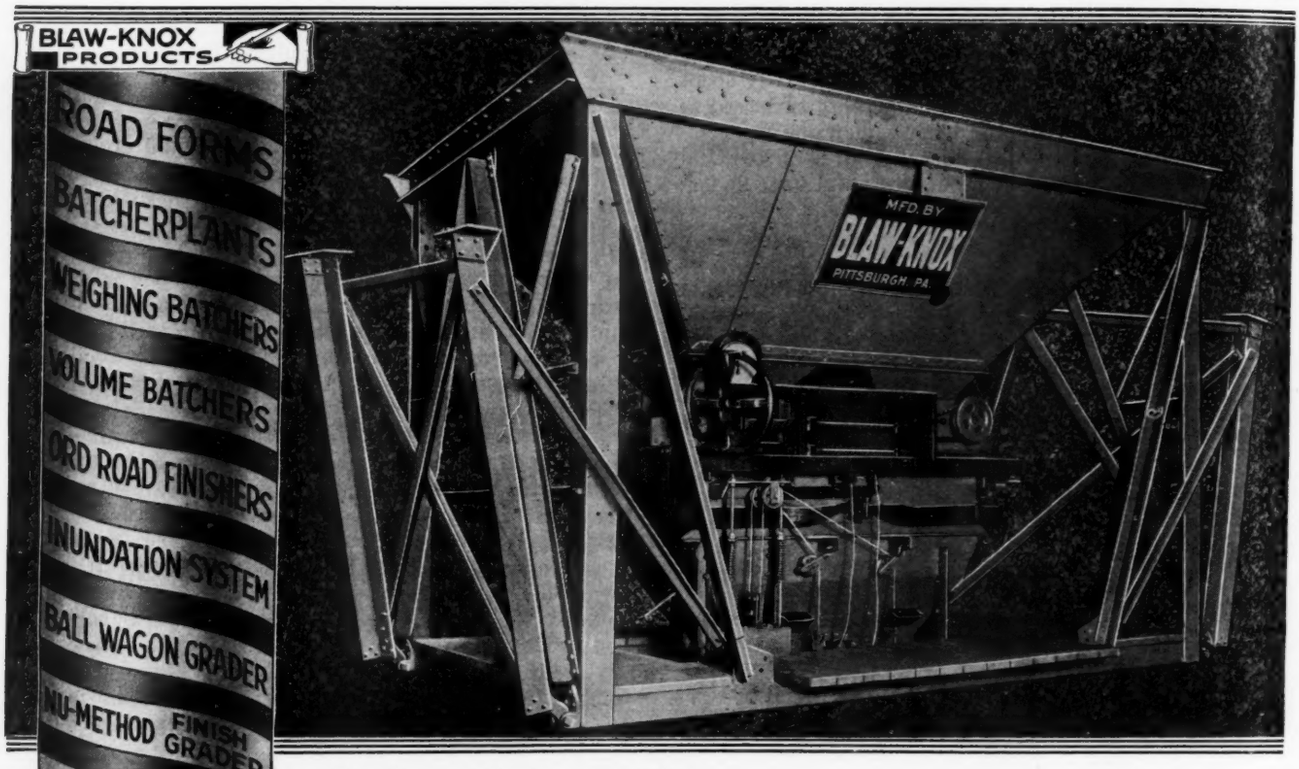

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Programs of Estimated State and Local Highway and Bridge Expenditures for Calendar Year 1930

(As Reported by State Authorities)

State	Grand Total Expenditures (Estimated) On State and Local Roads	PROBABLE EXPENDITURES BY STATE HIGHWAY DEPARTMENT							Probable Expenditures on Roads and Bridges by Local Authorities	Estimated Road Mileage to be Built by State Highway Departments				Miles of Road Maintained By State High'w Dep'tm't
		Total State Road Expenditures	Construction Expenditures			Maintenance§		Misc. Including Overhead¶		Total Mileage	Earth Improved	Sand-Clay Gravel, and Macadam	Asphalt Concrete and Brick	
			Total Roads and Bridges	Roads	Bridges	Reconstruction	Road Upkeep							
Alabama	$20,592,000	$12,592,000	$10,000,000	$6,400,000	$3,600,000	$400,000	$1,645,000	$547,000	$8,000,000	800	400	300	100	4,600
Arizona	7,520,000	5,700,000	3,560,000	3,160,000	400,000	250,000	1,250,000	640,000	1,820,000	458	123	325	10	2,150
Arkansas	27,100,000	22,500,000	17,400,000	13,000,000	4,400,000	.....	3,500,000	1,600,000	4,600,000	889	236	365	288	7,384
California	80,740,000	30,740,000	23,400,000	20,000,000	3,400,000	.....	6,240,000	1,100,000	50,000,000	950	....	450	500	6,400
Colorado	8,750,000	6,250,000	4,200,000	3,950,000	250,000	100,000	1,575,000	375,000	2,500,000	330	42	244	44	3,360
Connecticut	15,500,000	12,500,000	8,294,000	7,844,000	450,000	.....	3,074,000	1,132,000	3,000,000	†....	....	....	....	2,050
Delaware	3,360,000	2,110,000	1,630,000	1,600,000	30,000	.....	300,000	180,000	1,250,000	60	....	20	40	756
Florida	38,054,284	11,054,284	8,856,906	6,356,906	2,500,000	841,200	1,031,178	325,000	27,000,000	400	150	170	80	3,536
Georgia	27,100,000	17,100,000	13,500,000	12,900,000	600,000	500,000	2,500,000	600,000	10,000,000	750	200	50	500	7,000
Idaho	5,800,000	4,800,000	3,130,000	2,750,000	380,000	400,000	1,100,000	170,000	1,000,000	515	40	175	300	2,750
Illinois	64,250,000	40,250,000	36,250,000	33,750,000	2,500,000	.....	3,400,000	600,000	24,000,000	900	100	....	800	8,500
Indiana	50,071,000	23,071,000	18,000,000	16,000,000	2,000,000	.....	5,000,000	71,000	27,000,000	537	37	....	500	5,500
Iowa	61,723,000	39,723,000	36,400,000	35,000,000	1,400,000	.....	3,323,000	.....	22,000,000	1,600	400	200	1,000	7,175
Kansas	29,650,000	12,750,000	7,000,000	6,000,000	1,000,000	1,250,000	4,000,000	500,000	16,900,000	1,300	500	700	100	8,690
Kentucky	24,100,000	18,100,000	11,100,000	10,000,000	1,100,000	100,000	4,400,000	2,500,000	6,000,000	950	300	600	50	4,700
Louisiana	37,500,000	32,000,000	28,000,000	25,000,000	3,000,000	700,000	2,300,000	1,000,000	5,500,000	1,250	25	375	850	6,800
Maine	18,090,000	13,665,000	10,200,000	8,000,000	2,200,000	.....	2,960,000	505,000	4,425,000	553	4	515	34	5,000
Maryland	14,753,465	11,453,465	6,601,733	4,134,538	2,467,195	1,498,416	3,353,316	.....	3,300,000	250	....	72	178	2,830
Massachusetts	20,805,000	17,155,000	10,000,000	9,250,000	750,000	5,000,000	2,000,000	155,000	3,650,000	320	....	65	255	1,627
Michigan	60,775,000	29,775,000	23,000,000	20,000,000	3,000,000	.....	6,500,000	275,000	31,000,000	600	100	100	400	7,650
Minnesota	42,650,000	19,650,000	12,000,000	11,000,000	1,000,000	.....	4,500,000	3,150,000	23,000,000	685	230	230	225	6,955
Mississippi	11,000,000	6,000,006	3,000,000	2,500,000	500,000	.....	2,500,000	500,000	5,000,000	250	100	100	50	5,100
Missouri	56,981,000	38,981,000	34,081,000	32,251,000	1,830,000	.....	3,500,000	1,400,000	18,000,000	2,064	754	873	437	7,900
Montana	9,500,000	5,500,000	4,500,000	3,500,000	1,000,000	450,000	550,000	.....	4,000,000	793	492	301	....	2,281
Nebraska	24,515,000	9,515,000	5,750,000	5,000,000	750,000	50,000	3,200,000	515,000	15,000,000	1,050	400	550	100	6,400
Nevada	3,170,000	2,420,000	1,820,000	1,747,760	72,240	.....	500,000	100,000	750,000	487	....	282	205	1,837
New Hampshire	9,000,000	6,000,000	2,250,000	2,050,000	200,000	1,750,000	1,250,000	750,000	3,000,000	100	....	40	60	2,000
New Jersey	60,060,310	32,813,310	30,213,310	30,213,310	*.....	.....	2,500,000	100,000	27,247,000	†	....	....	....	1,175
New Mexico	7,550,000	7,275,000	4,150,000	4,000,000	150,000	1,000,000	1,400,000	725,000	275,000	1,175	950	225	....	6,000
New York	144,940,000	94,940,000	81,440,000	71,531,000	9,909,000	.....	9,500,000	4,000,000	50,000,000	1,433	†	....	....	10,939
North Carolina	24,250,000	11,250,000	6,000,000	5,300,000	700,000	1,000,000	4,000,000	250,000	13,000,000	375	100	150	125	9,200
North Dakota	8,462,727	4,462,727	2,332,543	2,237,543	95,000	.....	1,335,000	795,184	4,000,000	910	436	442	32	4,744
Ohio	86,000,000	37,000,000	23,000,000	17,000,000	6,000,000	6,000,000	7,000,000	1,000,000	49,000,000	480	25	35	420	11,350
Oklahoma	31,000,000	15,000,000	12,000,000	10,000,000	2,000,000	.....	3,000,000	.....	16,000,000	815	420	50	345	6,274
Oregon	16,000,000	10,000,000	6,000,000	5,000,000	1,000,000	1,000,000	2,500,000	500,000	6,000,000	400	100	100	200	3,600
Pennsylvania	169,835,000	81,835,000	42,205,000	42,205,000	*.....	10,650,000	17,689,000	11,291,000	88,000,000	1,025	100	275	650	13,338
Rhode Island	5,785,000	4,785,000	3,700,000	3,200,000	500,000	.....	800,000	285,000	1,000,000	60	....	....	60	533
South Carolina	26,737,209	22,737,209	20,000,000	18,000,000	2,000,000	.....	2,287,209	450,000	4,000,000	1,000	25	475	500	5,777
South Dakota	12,480,000	6,480,000	3,600,000	3,300,000	300,000	100,000	1,900,000	880,000	6,000,000	830	400	400	30	5,025
Tennessee	46,300,000	37,300,000	28,300,000	20,000,000	8,300,000	2,000,000	5,000,000	2,000,000	9,000,000	975	200	300	475	6,900
Texas	58,500,000	41,500,000	28,000,000	25,000,000	3,000,000	.....	12,000,000	1,500,000	17,000,000	1,650	800	150	700	18,020
Utah	4,200,000	3,000,000	2,000,000	1,750,000	250,000	.....	1,000,000	.....	1,200,000	275	20	250	5	3,430
Vermont	6,250,000	5,250,000	2,975,000	2,750,000	225,000	500,000	1,000,000	775,000	1,000,000	168	....	120	48	4,200
Virginia	24,537,460	17,037,460	12,500,000	12,500,000	*.....	.....	4,219,200	318,260	7,500,000	†	.. .	....	....	7,032
Washington	24,850,000	11,850,000	9,150,000	9,150,000	*.....	500,000	2,200,000	.....	13,000,000	192	11	138	43	3,400
West Virginia	24,080,000	17,080,000	13,800,000	13,300,000	500,000	.....	3,000,000	280,000	7,000,000	509	167	85	257	2,850
Wisconsin	42,600,000	21,800,000	16,500,000	15,000,000	1,500,000	.....	5,000.000	300,000	20,800,000	1,109	20	725	364	23,725
Wyoming	3,700,000	2,750,000	1,700,000	1,690,000	*.....	.....	780,000	280,000	950,000	310	120	190	....	2,950
TOTAL	$1,601,167,455	$937,500,455	$693,479,492	$616,271,057	$77,208,435	$36,039,616	$163,561,903	$44,419,444	$663,667,000	‡32,532	8,527	11,212	11,360	281,393

Remarks:—These estimates were made previous to any Congressional enactment increasing Federal aid allotments. Above expenditures exclude state road bond payments on interest and principal.

Notes:—§States reporting reconstruction under maintenance are so shown.
¶When no entry is shown overhead is included in construction and maintenance.
†Mileage segregation not reported.
*Bridge expenditures included with road construction.
‡Excludes 3 states as noted above, and includes New York not segregated.

Highway Expenditures in 1930

Figures reported to it by the authorities of the several states compiled by the U. S. Bureau of Public Roads early this year indicate that the amount to be expended in 1930 in highway work by state, county and other local authorities will total somewhat less than the expenditures for 1928 and 1929. The figures are shown in the accompanying table. The estimates were made by the state highway authorities previous to the recent congressional enactment increasing federal aid allotment by about $50,000,000 a year. However, this increase will have no direct effect upon expenditures this year; although there may be some indirect effect in encouraging the states to increase this year's expenditures knowing that the amount to be received from the federal government next year will be greater than in the past.

These figures were only estimates, of course, and in the case of a number of the states the legislatures had not yet acted upon their road program, and it is possible that, influenced by President Hoover's request for construction of the maximum possible amount of public works, the appropriations may exceed the estimate made by the state authority at the beginning of the year.

The last year for which the bureau has yet furnished complete returns of expenditures was 1928, and in that year the actual expenditures by states and their minor subdivisions totaled $1,684,653,549, which is about $83,500,000 more than the estimated expenditures for 1930. The 1928 expenditures by state governments totaled $849,326,598, which is less than the estimate for this year; while the expenditures by counties, townships and other local units in 1928 totaled $835,326,951.

The decrease of about 20 per cent in the expenditures by counties and other local units in the past two years is only a continuation of a tendency which has been in evidence for the past eight or ten years. In 1921 the expenditures on roads and bridges by counties, townships and other local political units amounted to $743,794,997, while similar expenditures by state governments totaled $405,642,899; the former being about 65 per cent and the latter about 35 per cent of the total expenditure. In 1928 the local units contributed a little less than half of the total amount spent and the state a little more than half, or 49.57 per cent and 50.43 per cent respectively. This change in relative expenditure has probably been due largely to the encouragement of state expenditure by federal aid, which must be expended under state supervision and must be at least matched by state appropriation. Also, it is being realized more and more that most of our highways are state or federal considerations rather than merely local ones, especially those receiving hard surface paving, which class of roads have received the most attention during the past few years. Another explanation is the fact that the gasoline taxes and motor car licenses are received by the states rather than by the local units, and these have increased from a total of about $104,000,000 in 1921 to about $716,000,000 in 1929.

The sums considered herein refer to the cost of work done and to be done and do not include interest and principal payments on road bonds.

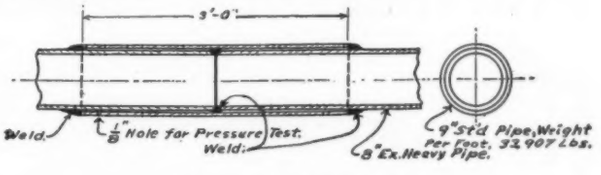
As compared with these figures, reported by the state authorities several months ago, we give elsewhere in this issue figures obtained from county engineers giving their opinions as to expenditures to be made this year as compared to expenditures made by the same counties during 1929.

New Joint for Steel Pipe

A new type of joint was used in laying a line of 8-inch steel pipe more than 5,000 feet long under the Hudson river from Beacon to Newburg, designed for a maximum pressure of 100 lbs. per square inch. Although this line is to be used for gas, the same joint would seem to have some advantages for water mains.

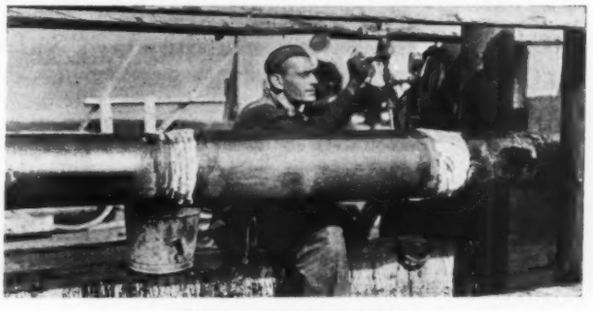
The joint is believed to reduce the possibility of the pipe line breaking at the joints when being lowered into the river from a barge, and also to make it possible to secure air-tight joints and test them with a minimum of time and effort.

The joint was made in the ordinary way with oxy-acetylene butt welding, and a sleeve of 9-inch pipe was slipped over the joint and each end of it welded to the pipe with fillet welds. Thus two of the three welds must leak for the joint to leak.



Section of Sleeved Joint

In each sleeve was a hole threaded for a ⅛-inch pipe nipple, by means of which compressed nitrogen was forced into the annular space between sleeve and pipe, testing all three welds at once. Nitrogen in cylinders under 1,800 lbs. pressure was used, as air compressors were not available. The pressure in the joint was brought up to 350 lbs. and soap suds painted over the sleeve welds. If the pressure dropped and no leaks could be detected in the sleeve welds, this indicated that the butt weld was faulty; but this happened only once in the 163 joints in the crossing. The annular space had a volume of about 0.1 cu. ft. and only nine cylinders of nitrogen were used in the testing.



Testing Sleeved Joint

Part of the fleet of trucks operated by Antonio Gonnelli, contractor, Providence, R. I. Experience has proved the added quality built into Goodrich Heavy Duty Silvertowns.

"EXPERIENCE HAS C

Antonio Gonnelli, *Contractor, P*
service that Goodrich Heavy Duty Si

WHEN you reduce this heavy duty tire problem down to cold, practical business facts, there is *only* one basis on which any product can be judged. Did it or did it not deliver the goods—did it do the job?

What do experience, actual service, day-in and day-out hard work have to say about the stamina, the endurance, the inbuilt toughness of the tire?

Experience points a cold relentless finger at *results*. It has no other basis on which to judge, no other standard of values. There is no reservation, nothing short of positive conviction in Antonio Gonnelli's statement "Goodrich Heavy Dutys are all that you claimed them to be. Experience has convinced us as to the economy and the wisdom of using Silvertowns."

Gonnelli's trucks, as pictured above, are doing the heaviest kind of excavation hauling. As in the case of Antonio Gonnelli, truck operators everywhere write in voluntarily and say "Silvertowns do the job. We are getting the results we expected to get."

Goodrich HEAVY DUTY

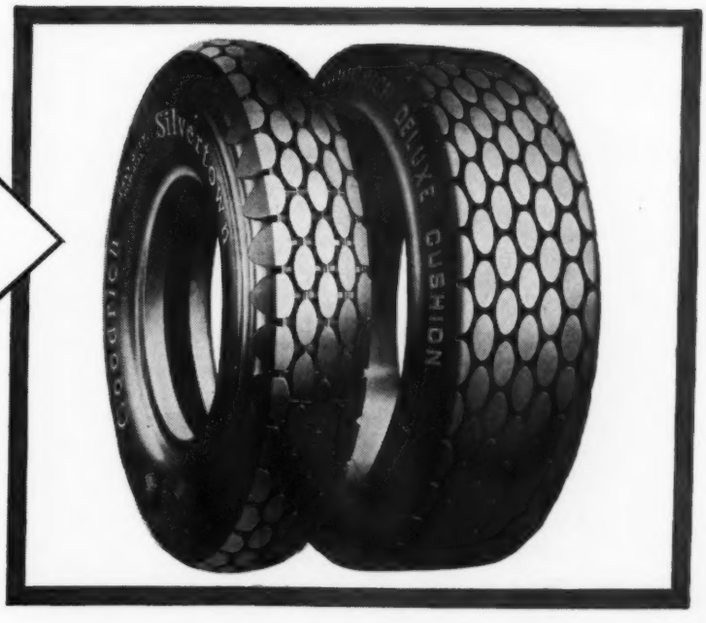
SPECIFY GOODRICH

CONVINCED US"

Providence, R. I., concludes from actual Silvertowns operate most economically

RECOMMENDED FOR HEAVY HAULING

(Left) The new Goodrich Heavy Duty "Universal" Silvertown with improved traction tread. (Right) Goodrich De Luxe Cushion Safety with extra thick, tough tread.



The B. F. Goodrich Rubber Co., Established 1870, Akron, Ohio. Pacific Goodrich Rubber Co., Los Angeles, Calif. In Canada: Canadian Goodrich Co., Kitchener, Ontario.

Silvertowns

ON YOUR NEW TRUCKS

For latest catalogs — consult the *classified* INDUSTRIAL LITERATURE section, pages 133 to 140.

English Ideas on Refuse Collecting

Westminster tests of special rubbish cans and collection vehicles to prevent exposing contents, while loading, to sight and wind, use of ladders in loading and eliminate other defects of the present system

The city of Westminster, England, has been considering the matter of vehicles for collecting refuse and a report on the subject was made by the city cleansing surveyor and the city controller through the highways committee, giving statistics relating to tests which had been made during the year 1929 with various types of refuse collecting vehicles in that city; which vehicles included thirteen 4½-ton motor wagons, four 3- to 4-ton motor wagons, fourteen 2- to 3-ton motor wagons, a 2-ton freighter, eight 2-horse trucks and 26 single-horse trucks. All of these except the 2-ton freighter have open bodies and high loading lines and "possess the following serious defects for refuse collection purposes:

"a. The refuse is exposed to public view until the vehicles are loaded and covered.

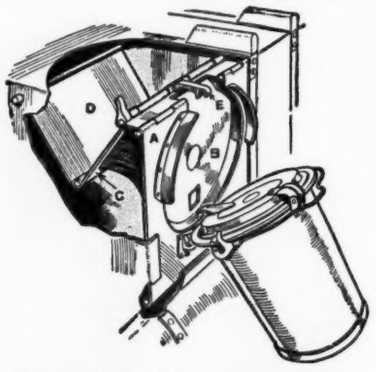
"b. The contents of the vehicles are blown about the streets, especially in windy weather.

"c. Time is lost in covering the vehicles with sheet, which cannot prevent completely the escape of some of the refuse during transit.

"d. Ladders have to be used in loading the vehicles.

"e. The system is unsanitary, both from the point of view of the public and that of the men engaged on the work.

"f. Owing to the sanitary defects of the existing transport, it is desirable to collect refuse during the night or early morning in areas where it would otherwise be practicable to collect during the day."



Ess-Em Rubbish Can and Shutter

During 1928 the council authorized the city officials to carry out experiments with the use of the Ess-Em system, for which purpose 650 rubbish cans with fixed lids and designed especially for use with the Ess-Em shutters, and two enclosed cylindrical steel bodies of 8 cubic yards capacity with Ess-Em shutters were purchased and mounted on two existing chassis. It was found, however, that only one of these vehicles was needed to collect from the premises to which the 650 dust bins had been distributed.

The use of this equipment began in March 1929. In July a vehicle known as the "Faun," incorporating the Ess-Em shutters, was loaned to the council for five days by the concessionaire of the Ess-Em system; this vehicle having an enclosed steel body of approximately 13 cubic yards capacity. In June two freighters of 7 cubic yards capacity, having a low loading line and provided with sectional metal covers which are operated by the foot pressures of the loaders, were loaned to the council for the test. The city did not have on hand sufficient rubbish cans to provide a full day's work for the Faun vehicle, so that the test of this could not be carried out in a satisfactory manner.

Compared with the 3- to 4-ton trucks and the 2- to 3-ton trucks, the collection by the Ess-Em system cost from 50% to 150% more per ton of matter collected. The Highways Committee reported, following this test, that "the Ess-Em system of refuse collection is the most dustless and hygienic system which has been tested" and that the main reason for the high cost of collection by it was that the bodies used had a small loading capacity, only 8 cubic yards, but that further experiment was necessary before the council can be satisfied that it has found a dustless loading vehicle capable of collecting refuse economically under Westminster conditions. It recommended that the low freighters which the city already used be adapted to take the Ess-Em shutters with a view to combining the dustless loading of the Ess-Em system with the economic working of the freighter. Also it recommended that a horse-drawn vehicle be fitted with these shutters so as to learn the cost of collecting refuse by a dustless horse-drawn vehicle.

One disadvantage of special equipment provided with Ess-Em shutters is that it cannot well be used for other purposes, while the trucks now employed can be used for hauling other materials when there is a seasonal falling off of rubbish collection.

Finally, the committee recommended that a new set of tests be conducted using a specially designed motor truck and specially designed horse-drawn truck, and the freighter, all adapted to take Ess-Em shutters; that an additional 700 special rubbish cans be purchased, and that another test be made of the Faun vehicle after the purchase of these additional rubbish cans so as to give it a fair test at capacity.

Low Cost Graveling in Ellsworth, Kans.

The city of Ellsworth, Kansas, in a recent job of street improvement used sand from its own pits and paid 75 cents per cu. yd. for hauling. The county graded the streets with its machinery, charging $20 a day therefor. Total paid the county was $80. Total cost for project: $1,697.31. This graded and graveled about 2 miles of streets.—(*Kansas Municipalities.*)

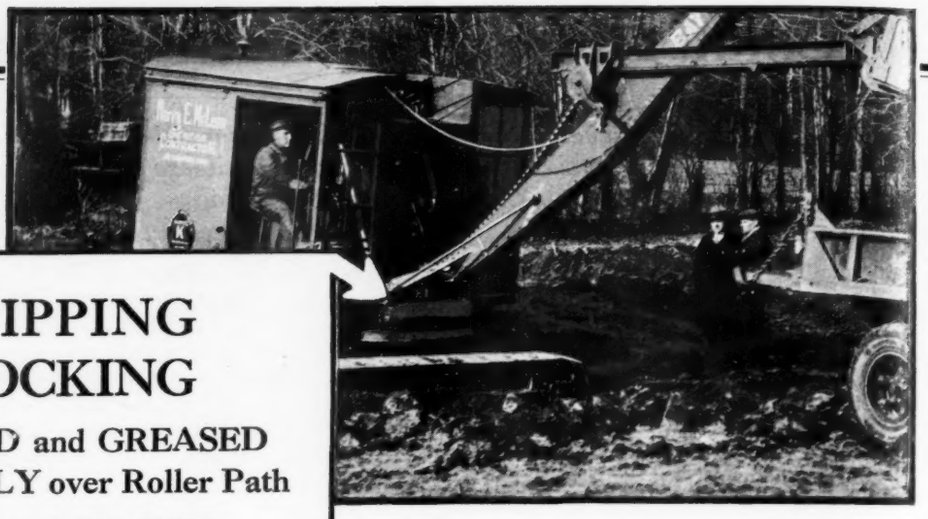
County Road Improvement in 1929

Miles of the several kinds of highway improvement constructed during the year 1929 by six hundred counties, and mileage at the end of the year. Width of paved surfaces

Six hundred county engineers or other county highway officials had, at the time of compiling the following tables, replied to questionnaires sent out about a month ago asking for this information. As these replies are official, come from all sections of the country, and from about one-fourth of all the counties which did any work last year, we believe the figures give a fairly accurate picture of the county highway work done throughout the country—the kinds of improvement, the relative amounts and the width of each kind. These figures indicate an expenditure by counties on highway work of nearly half a billion dollars last year. They also show a considerable percentage of hard-surface pavement being laid in all sections of the country.

Length of Roads Gravelled in 1929

	Miles Laid in 1929	Miles in County, End of 1929	Width of Surface Feet
Alabama—			
Montgomery	9	500	20
Arizona—			
Apache	20	..	..
Coconino	15	200	16
Arkansas—			
Benton	25	450	..
Carroll	3	..	..
Craighead	10	..	..
Cross	6	20	..
Desha	5	14	14
Lafayette	10	50	18
Pulaski	14	..	24
California—			
Alameda	11	302	20
Alpine	3	..	..
Napa	3	180	20
San Joaquin	16	86	12-16
Siskiyou	20	20	20
Colorado—			
Arapahoe	80	1000	20-24
Crowley	6	53	23
Elbert	30	200	20
Moffat	1	..	18
Rio Blanco	5	30	24
Florida—			
Martin	7	..	..
Georgia—			
Muscogee	5	25	20
Idaho—			
Bonner	20	35	12-20
Bonneville	18	213	12-20
Nez Perce	5	73	20
Twin Falls, H.D.	20	182	26
Illinois—			
Boone	30	260	10-30
Bureau	7	262	20
Calhoun	2	22	12
Carroll	19	57	12-14
Crawford	10	316	24
DeKalb	11	110	16-20
Douglas	10.5	790	..
Kankakee	2	66	9-12
Lake	15	..	..
Livingston	200	700	8-12
Menard	4	..	..
Marshall	17	..	14
McLean	350	425	10-16
Richland	2.5	..	..
Sangamon	6	6	18
Winnebago	17	50	24
Woodford	20	25	9-12
Indiana—			
Boone	10	650	24
Clinton	6	1090	12
DeKalb	35	425	12
Harrison	5	262	30
Howard	2	627	12
Huntington	30,788 cubic yards		
Jay	4	..	..
Jennings	1	302	9-15
Kosciusko	20	..	16
Lake	15	400	12-18
Monroe	15	400	12-16
Ohio	4.5	80	12-14
Posey	10	..	..
Putnam	6	692	10-18
Randolph	16	273	40
Rush	1.7	..	12
Shelby	2	..	16
Starke	8	423	8-12
Iowa—			
Black Hawk	27	180	..
Boone	6.2	140	24
Bremer	7	..	..
Buchanan	50	200	24
Buena Vista	52	555	22-24
Delaware	11	75	26
Dubuque	4.5	43.4	26
Emmet	19	661	..
Fayette	1.5	38.3	26
Grundy	10	..	26
Guthrie	4	42	26
Hamilton	38	320	24
Harrison	6	..	..
Howard	12	..	20
Humboldt	38	234	24-26
Jasper	14	67	..
Kossuth	58	704	24
Linn	30	261	..
Marion	10.3	13.3	24
Muscatine	9.6	105.4	24
O'Brien	10	..	24
Plymouth	29	..	28
Palo Alto	33.2	312	24
Pocahontas	11.5	364	22-26
Shelby	1	..	..
Sioux	40	..	..
Story	16	400	12-18
Winnebago	8	55	24
Kansas—			
Barber	15	40	28
Barton	6	13	28
Butler	4	4	18
Cherokee	35	350	18
Franklin	52	93	28
Haskell	12	..	..
Harper	12	30	28
Labette	55	290	18-20
Harvey	19	95	..
Lyon	15	67	16-24
Pottawatomie	10	10	28
Rush	14	..	..
Shawnee	12	68	18
Sumner	50	80	..
Sedgwick	75	..	30
Wilson	17	118	20
Kentucky—			
Floyd	20	..	..
Fleming	20	70	14
Jefferson	3	100	30
Louisiana—			
Red River	11	140	14
Lafourche	18	..	..
Michigan—			
Algona	3	10	9
Allegan	16.5	315	9-16
Calhoun	35	425	24
Chippewa	8	163	26
Crawford	2.5	40	9
Genesee	18	491	15
Hillsdale	16	234	9-16
Iosco	6	90	9-?2
Ingham	22	352	16
Jackson	30	411	9
Kalamazoo	25.5	300	9-20
Kalkaska	5.5	39	9
Leelanau	8.3	138	9-20
Mackinac	5.	..	20
Mason	1	140	16
Menominee	13.3	304	..
Minnesota—			
Aitkin	48	150	24
Beltrami	17	..	..
Benton	32	104.5	..
Big Stone	13	95	24
Blue Earth	16.1	252	24
Brown	27	156	20
Carlton	12	230	24
Carver	12	..	24-30
Cass	15	60	24
Chisago	12.5	..	26
Clay	28	202	..
Faribault	31	383	20-22
Fillmore	70	400	..
Goodhue	30	..	..
Isanti	7	..	24
Jackson	12	170	22
Kanabec	8	64	24
Kittson	12	..	..
Lac qui Parle	18	184	24
Lake of the Woods	59	..	..
Lincoln	65	154	24
Mahnomen	5.5	..	..
Marshall	12	208	24
Martin	8	203	..
McLeod	83	600	24
Mower	69	196	24
Murray	7	155	24
Norman	20	..	24
Olmsted	10	140	24
Pennington	11	110	24
Pine	5	60	24
Pipestone	19.3	129	24
Redwood	82	824	22-28
Rock	3	126	24
Scott	10	90	..
Sherburne	10	150	..
Sibley	52.6	741	24
Stearns	250	..	..
Steele	13.5	133	20
Stevens	34.8	143.7	..
Todd	103	194	18-22
Waseca	20	174	24
Washington	8	82	24
Watonwan	40	310	30
Winona	20	300	20-24
Yellow Medicine	20	..	..
Mississippi—			
Carroll	15	58	20
Chickasaw	90	..	..
Grenada	7	30	9-18
Lauderdale	15	127	18
Madison	10	200	12-20
Oktibbeha	18	..	..
Quitman	25	400	14
Yalobusha	3	..	..
Missouri—			
Barton	4.8	45	24
Boone	3	35	9
Callaway	.6	42	12
Miller	10	..	..
Ralls	10	..	..
Taney	5	5	..
Montana—			
Big Horn	10	111	18-24
Chouteau	10	20	18
Daniels	1	..	..
Powder River	14	25	24
Roosevelt	10	15	24
Rosebud	7	33	12



NO TIPPING
NO ROCKING

EASILY OILED and GREASED
BOOM DIRECTLY over Roller Path

MEANS MORE
YARDAGE

—and more yardage means

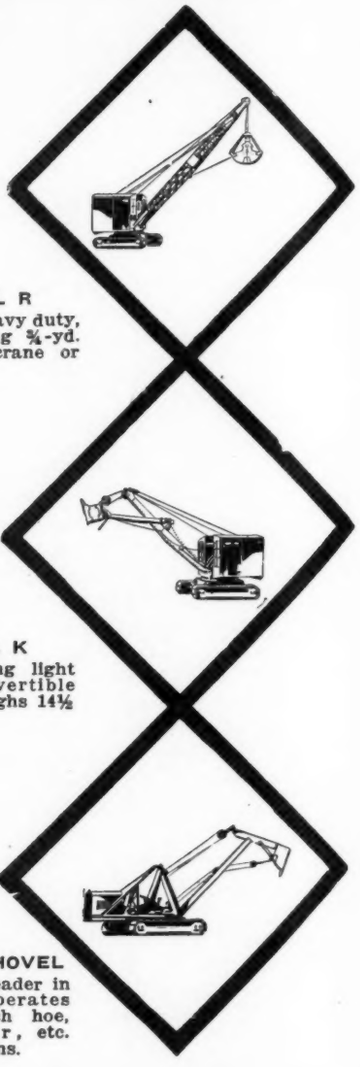
LONGER PROFITS

EXCESSIVE profits are strangers to the contractor in these days of close bidding, but you can make *longer profits* through *greater yardage* by putting the BAY-CITY Model K to work.

Model K is a light ½ yard full revolving shovel, convertible to crane, dragline, skimmer and trench hoe. Short tailswing permits working in close quarters. Independent friction clutches on each separate crawler makes it possible to turn around in minimum space.

The 8-in. center pin and the 6 foot roller path, equaling or exceeding similar parts on one yard machines, plus the mounting of the base of the boom less than 30-in. from the center pin, reduces rocking or tipping to an absolute minimum and mechanically balances the machine. This also enables the Model K to handle the same size buckets and same length booms that are used on machines three to five tons heavier—meaning economy and greater yardage with the flexibility and efficiency of a light ½ yard machine.

Investigate the Model K . . . Write us for further information or the name of our nearest distributor.



MODEL R
A 26-ton, heavy duty, full revolving ¾-yd. shovel, crane or dragline.

MODEL K
Full revolving light ½-yd. convertible shovel. Weighs 14½ tons.

TRACTOR SHOVEL
Recognized leader in its field. Operates shovel, trench hoe, backfiller, etc. Weighs 10 tons.

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New York Office—302 Broadway, BAY CITY, MICH.

BAY-CITY SHOVELS

THE BAY-CITY FAMILY OF FAST WORKERS

For latest catalogs — consult the *classified* INDUSTRIAL LITERATURE section, pages 133 to 140.

Roads Gravelled in 1929 (continued)

	Miles Laid in 1929	Miles in County, End of 1929	Width of Surface Feet
Nebraska—			
Cheyenne	35	117	..
Clay	10	25	..
Douglas	20	120	32
Johnson	4	..	..
Otoe	30	98	21
Platte	3.5	..	..
Saunders	7	30	24
New Jersey—			
Cape May	.8	..	50
New York—			
Albany	44.7	121.3	..
Allegany	8	60	14
Cayuga	15	..	..
Chemung	8	19	16
Chautauqua	7	..	..
Westchester	9.3	..	..
Wyoming	3	..	..
North Carolina—			
Chowan	11	11	20
North Dakota—			
Barnes	30	252	..
Burke	6	..	..
Burleigh	7	36	26
Cass	30	..	..
Eddy	19	74	18-24
McLean	64	103	20
Ohio—			
Brown	1	30	13
Carroll	20	174	24
Hocking	19	155	18
Holmes	25	75	12
Logan	3	656	14-18
Morrow	10	50	10-15
Muskingum	90	300	8
Ottawa	20	323	12-20
Preble	40	840	12-16
Richland	55	283	12-16
Monroe	7	..	9
Tuscarawas	55	461	16
Union	6	640	10
Wayne	55	205	..
Williams	25	92	..
Oklahoma—			
Blaine	3	3	20
Delaware	12	..	..
Garfield	10.5	108	18
Kay	33	42	20
Payne	10	40	24-30
Pottawatomie	45	120	..
Tulsa	6	60	20
Oregon—			
Benton	9	380	8-16
Coos	15	320	16
Douglas	20	856	..
Gilliam	12	..	18
Jackson	29.5	350	16
Lane	15	875	16
Lincoln	9	196	16
Morrow	35	..	9-16
Umatilla	22	..	22
Yamhill	7.8	157	16-20
Tennessee—			
Bradley	5	..	..
Hamilton	10	600	20
Knox	170	1000	..
Robertson	10	150	..
Tipton	25	30	..
Texas—			
Cooke	10	100	40
Dallas	170	1268	18
Foard	6.5	6.5	18
Fort Bend	10	40	16
Grayson	30	90	20-30
Guadalupe	7	..	18
Hood	30	..	..
Kent	41.4	..	..
Morris	7	..	..
Rusk	25	125	24
Uvalde	9.5	..	..
Utah—			
Carbon	8	..	20
Grand	9	30	18
Utah	7	94	12-18
Virginia—			
Campbell	3	..	22
Washington—			
Adams	37	117	16
Asotin	1	50	..
Douglas	15	..	..
Franklin	27	281	10-12
Garfield	8	..	20
Island	7	200	24
Lincoln	60	500	14-20
Pacific	8	..	..
Pend Oreille	2	..	20
Snohomish	22	1250	22
Spokane	17.8	327	18
Walla Walla	4.8	327	12-18
West Virginia—			
Berkeley	40	100	20
Tyler	9.6	60	14
Wyoming	6	..	..
Wisconsin—			
Adams	9	70	26
Bayfield	30	154	26
Burnett	15	90	26
Dane	116	..	26
Calumet	7	78	20
Lafayette	185	600	22
Monroe	10	..	..
Richland	38	210	24
Sawyer	15	6	..
St. Croix	86	..	..
Sheboygan	37	250	24
Sauk	50	550	18
Vilas	11.5	50	20
Walworth	25	150	20-24
Washington	25	200	20
Waushara	15	400	20
Wyoming—			
Lincoln	15	110	20
Platte	34	38	24
Sheridan	19	32	10-16

Sand-Clay or Top-Soil Laid in 1929

	Miles Laid in 1929	Miles in County, End of 1929	Width of Surface Feet
Alabama—			
Crenshaw	10	..	..
Colorado—			
Arapahoe	125	1000	20-24
Boulder	3	209	..
Elbert	120	1650	20
Arizona—			
Apache	20	..	..
Coconino	10	80	16
Arkansas—			
Hot Springs	400	..	..
Florida—			
St. Lucie	8.5	18	9
Georgia—			
Mitchell	20	..	40
Muscogee	10	75	30
Telfair	30	..	..
Oconee	5	..	28
Illinois—			
Macoupin	50	30	30
Iowa—			
Black Hawk	15	..	..
Kansas—			
Butler	17	25	22
Cowley	5	5	18
Haskell	20.5	..	..
Kingman	7	90	32
Reno	30	150	24
Rush	50	..	..
Riley	4	..	30
Shawnee	10	80	20
Wabaunsee	15	18	28
Louisiana—			
Red River	5	15	..
Michigan—			
Crawford	18	60	30
Keweenaw	3.6	10	24
Minnesota—			
Lake of the Woods	16	30	20-24
Sibley	4	28	24
Wadena	9	..	..
Mississippi—			
Grenada	.5	.5	16
Lauderdale	15	150	24
Oktibbeha	5	..	..
Winston	30	275	24
Missouri—			
Atchison	29	..	..
Taney	15	15	20
North Carolina—			
Catawba	15	400	28-30
Nash	30	370	26
Chowan	12	35	24-30
Oklahoma—			
Kay	30	30	20
Kingfisher	1.7	35	18
South Carolina—			
Chester	10	150	18-34
Darlington	57.5	1275	30

County Highway Expenditures in 1930

The counties will spend between five and fifteen percent more on highways this year than they did last, unless something unforeseen happens. The basis of this prediction is explained in the following paragraphs

The counties of the States of the Union will, taken collectively, spend a little more this year on road work than they did in 1929. Some individual counties will spend more, some less, and some about the same; but the total for the country will exceed last year's expenditures by something less than fifteen percent—6.6 per cent, judging by the figures furnished by six hundred counties reporting to us last month.

It will be well first to form an opinion of how closely our informants—all county engineers or other county officials—estimate what this year's expenditures will be; and to do this we have taken similar estimates furnished a year ago concerning 1929 expenditures and compared them with the actual 1929 expenditures, for the same counties, as reported this year. Only four counties give exactly the same figures, to the nearest thousand, both times. But while 59 percent spent more than their estimates and 41 percent spent less, the figures in general were fairly close, and the totals of the estimates of all reporting *differed by only* 0.2 *percent* from the total actual expenditures.

We do not, of course, claim that this year's estimate will be as close; but it does seem probable that it will come within ten, or possibly five, percent of the actual expenditure. Also, we believe that such expenditure will be greater than the estimate rather than less, since the financial prospects of the country seem to have been improving during the several weeks since these estimates were made.

The six hundred counties reporting constitute just about one-fourth of all of those in the country which

AIR

can do your roads more good

—than an army of workers and sprinklers

An application of Flake Calcium Chloride puts the natural moisture from the air to work on gravel and dirt road surfaces and keeps them smooth and dustless.

Flake Calcium Chloride always stays on the job and keeps down dust where constant sprinkling affords only temporary relief at continual expense. Then too, Flake Calcium Chloride saves money in maintenance by reducing the amount of surface replacement material needed.

Give your locality the advantages of dustless roads with the low maintenance costs which are assured by the use of Flake Calcium Chloride.

Write to any of the companies listed here for full information. Ask for booklet 844.

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FLAKE **CALCIUM CHLORIDE**

CONTROLS DUST

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Sand-Clay or Top-Soil (continued)

	Miles Laid in 1929	Miles in County, End of 1929	Width of Surface Feet
Tennessee—			
Bradley	15	..	..
Texas—			
Andrews	20	20	..
Dallas	75	..	20
Gaines	50	..	..
Virginia—			
Campbell	17.4	172	22
Franklin	16	45	..
Fauquier	16	140	24
Halifax	20	240	22
Pittsylvania	35	325	20
Washington—			
Island	5	80	20
Wisconsin—			
Adams	5	105	22-26
Bayfield	15	350	26
Vilas	3.5	58	24

Bituminous Macadam

	Miles Laid in 1929	Miles in County, End of 1929	Width of Surface Feet
Arkansas—			
Benton	5	5	..
California—			
Monterey	15	110	18
Napa	11	14	20
San Joaquin	13	420	16 to 18
Siskiyou	12	12	20
Solano	15	..	..
Florida—			
Martin	8	..	16
Palm Beach	3	251	16-21
St. Lucie	1 W	88	16
Georgia—			
Terrell	10	10	18
Indiana—			
Howard	3	5	18
Lake	15	260	..
Randolph	15	37	20
Warrick	2.7	26	14
Kentucky—			
Greenup	10	..	..
Jefferson	20	450	..
Kenton	75	175	18
Michigan—			
Huron	3	8	16
Minnesota—			
Blue Earth	4.6	4.6	24
Norman	4	..	20
Sibley	5.5	11	20
Missouri—			
Atchison	15	15	9
New York—			
Albany	2.1	8.6	..
Allegheny	12	60	14
Cayuga	27	387	12-16
Chemung	6.2	58.2	16
Chautauqua	20	..	..
Herkimer	70.9	117	10-14
Orleans	11.5	74	14
Seneca	7	54	12-14
Sullivan	10.5	103	13
Tompkins	16	132	10
St. Lawrence	16.3	96.9	10-14
Yates	6	..	12
Wayne	14.5	116	12-14
Westchester	21.6	140	..
North Carolina—			
Chowan	3	5.5	16
Ohio—			
Guernsey	11	..	12
Ottawa	5	38	16
Seneca	30	..	10-16
Richland	3	121	12-18
Wood	47	507	12-16
Oregon—			
Multnomah	13	37	20
Pennsylvania—			
Mifflin	3	71	18
Tennessee—			
Hamilton	10	200	24-36
Texas—			
Dallas	8.5	170	20
Rusk	21	50	18
Virginia—			
Campbell	1.8	16	16
Utah—			
Utah	2.5	2.5	18
West Virginia—			
Berkeley	25	150	20-24
Brooke	1.5	..	14
Fayette	8	205	10-12
Wisconsin—			
Monroe	13	..	..
Washington	.7	2	20

Bituminous Concrete

	Miles Laid in 1929	Miles in County, End of 1929	Width of Surface Feet
Alabama—			
Mobile	3.5	..	18
Arkansas—			
Pulaski	5	..	18
California—			
San Joaquin	3	28	18-20
	4.5 W	4.5	18
Indiana—			
Lake	5	25	18-40
Randolph	15	37	40
Pennsylvania—			
Lackawanna	4	..	18

W—Warrenite-Bitulithic.

Rock Asphalt

	Miles Laid in 1929	Miles in County, End of 1929	Width of Surface Feet
Alabama—			
Mobile	14	..	18
Arkansas—			
Sebastian	2	..	..
Kentucky—			
Kenton	2	2	18
Minnesota—			
Carver	8	11	26
Mississippi—			
Madison	2	2	18
New York—			
Erie	19.2	88	12-24
Oklahoma—			
Bryan	15	..	18
Texas—			
Jim Wells	9.7	77	18
Guadalupe	7	45	16
Matagorda	4.5	5.5	18
Uvalde	17.5	..	..
Webb	1.5	..	18

Cold Bituminous

	Miles Laid in 1929	Miles in County, End of 1929	Width of Surface Feet
Alabama—			
Mobile	1.5 A	..	18
Indiana—			
Madison	2. E A	20	18-30
Kentucky—			
Nelson	9	..	16
Michigan—			
Mason	6	10	18
Minnesota—			
Carlton	2	2	30
Missouri—			
Miller	60	1200	20
New York—			
Sullivan	10	80	13
Wyoming	13	..	14
North Dakota—			
Burleigh	5	5	24
Tennessee—			
Hamilton	10	10	..
Texas—			
Cameron	40	200	16-18
Utah—			
Rich	20	20	20
West Virginia—			
Tyler	1	1	10-20
Wisconsin—			
Vernon	3.5	3.5	20

A—Amiesite; E A—Emulsified Asphalt.

will do any highway work this year. They report having done $116,035,000 worth of highway work last year, and their estimate of the amount to be done in 1930 is $123,663,000, or 6.6 percent more.

Not all counties, of course, expect an increase in work this year. But 48½ percent do, while 18 percent expect to spend about the same as last year, and 33½ percent of them expect to spend less.

Considering the counties in groups according to the geographical division of States indicated on the accompanying map (omitting the New England States, as very little road work is done by the counties as such in that section of the country), we find that in the Pacific States and also in the Mountain States the same amount of expenditure is anticipated for 1930 as in 1929.

In the South Atlantic States a falling off of 7½ percent is expected, and in the East South Central, 11 percent.

In all the other sections, increases are expected, as follows:

Middle Atlantic	18¼ percent
East North Central	1 percent
West North Central	8¾ percent
West South Central	23½ percent

Analyzing the figures to learn what percentage of counties in each geographical section expect that the 1930 expenditures will exceed those of 1929, and what percent that they will be less, we find as follows:

Middle Atlantic: 69 percent expect an increase, 20½ a decrease, and 10½ percent no change.

South Atlantic: 27½ percent expect an increase, 42½ percent a decrease, and 30 percent no change.

East South Central: 22½ percent expect an increase, 43 percent a decrease, and 34½ percent no change.

East North Central: 55 percent expect an increase, 35 percent a decrease, and 10 percent no change.

West North Central: 56 percent expect an increase, 33 percent a decrease, and 11 percent no change.

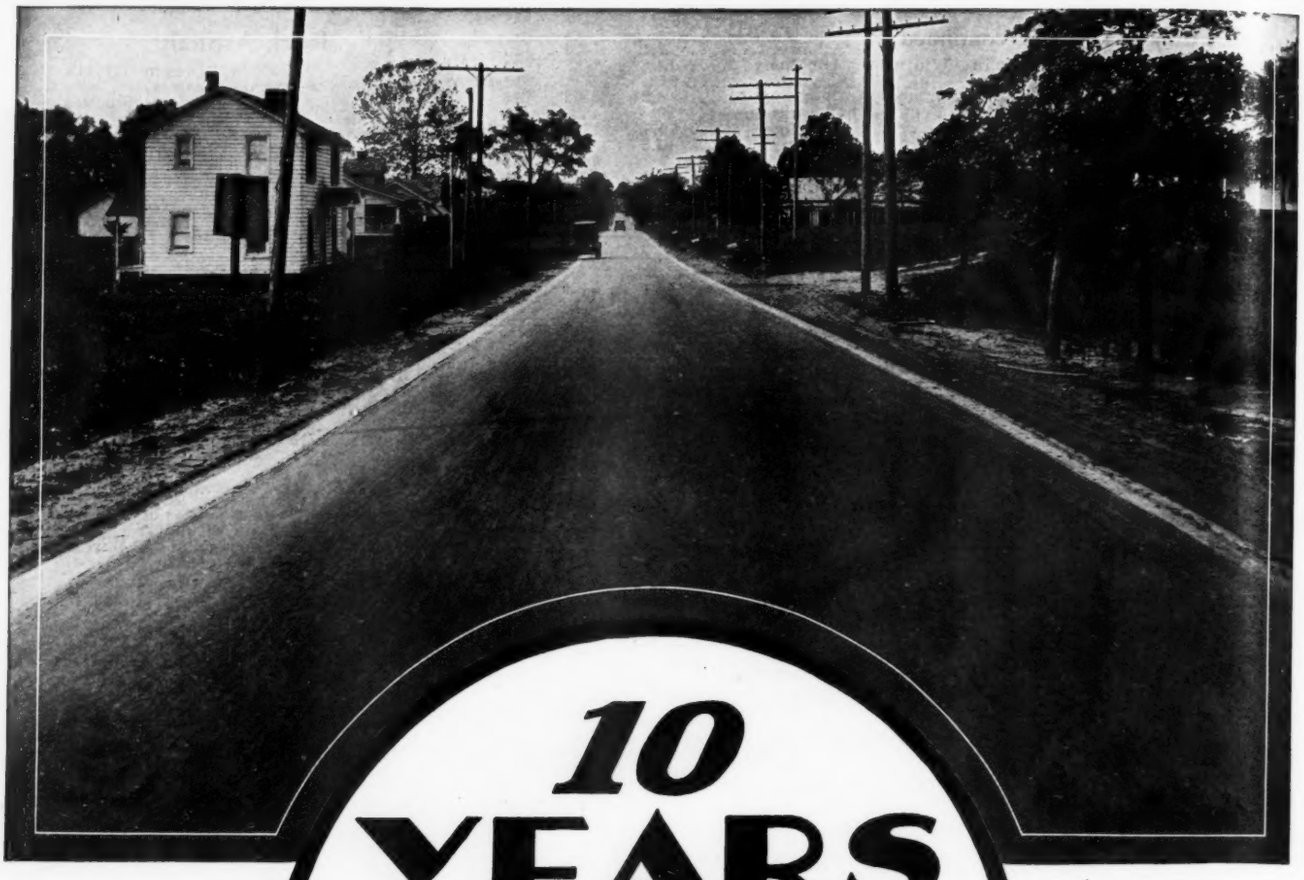
West South Central: 42 percent expect an increase, 24 percent a decrease, and 34 percent no change.

Mountain: 36 percent expect an increase, 42½ percent a decrease, and 21½ percent no change.

Pacific: 64 percent expect an increase, 25 percent a decrease, and 11 percent no change.

The average expenditures per county last year were as follows:

Middle Atlantic States	$520,000
South Atlantic	108,000
East South Central	196,000
East North Central	254,000
West North Central	138,000
West South Central	240,000



Durham-Chapel Hill Road. Built by North Carolina State Highway Commission in 1920. Carries major traffic. No maintenance to date.

10 YEARS without a cent of cost *for* MAINTENANCE *to this* Kyrock SURFACE

8 miles of perfect pavement through picturesque North Carolina scenery. 4 miles on 5-inch concrete, 4 miles on macadam. All surfaced with Kyrock.

Another veteran Kyrock surface, demonstrating that the real cost of a road is its original cost *plus maintenance cost over a period of years.* When this is taken into consideration it will be found that Kyrock is the cheapest material available today.

This Kyrock surface has been under traffic ten years, with no maintenance to date. It is apparently as good today as when laid. Kyrock is non-skid, non-reflecting and resilient. It is laid cold. Kyrock possesses many advantages which you should know about—

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Kyrock

KENTUCKY ROCK Kyrock ASPHALT

The Uniform Pavement

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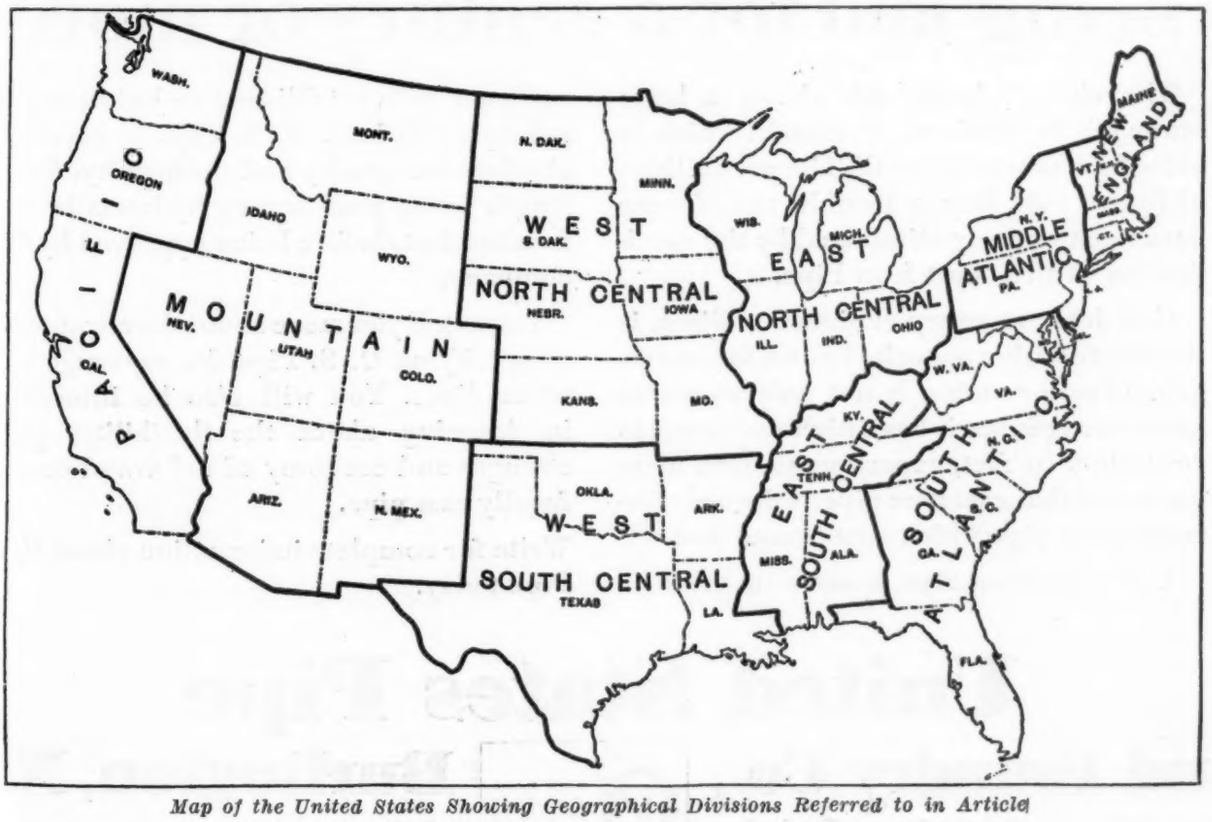
Concrete

	Miles Laid in 1929	Miles in County, End of 1929	Width of Surface, Feet
Alabama—			
Mobile	1	43	18
Arizona—			
Gila	.5	8	18
Arkansas—			
Benton	10	18	18
Franklin	15	15	22
Sebastian	4	..	..
California—			
Fresno	..	30	16
Monterey	22	24	24-40
Napa	..	52	18
Georgia—			
Emanuel	4	..	..
Monroe	..	22	18
Muscogee	5	53	18-20
Illinois—			
Bureau	..	6	16
Carroll	8	80	18
Crawford	..	45	18
DeKalb	..	70	18
Iroquois	44	270	10-18
Kankakee	..	25	9
Livingston	9	200	9
Sangamon	.5	120	18
Vermilion	11	275	16
Williamson	2	95	10-18
Winnebago	..	100	18
Indiana—			
Clinton	1.6	26	20
Howard	..	7	20
Jay	.5	..	..
Lake	15	175	18-40
Madison	15	100	18-30
Posey	1	..	..
Randolph	3	28	18
Shelby	9	40	18
Vermillion	3.2	35	16-18
Iowa—			
Audubon	10 S	10	18
Warren	10.4	26	18
Kansas—			
Allen	.6	.6	18
Harvey	.2	.5	..
Kentucky—			
Kenton	5	50	18
Louisana—			
Tangipahoa	22	10	18
Michigan—			
Calhoun	1.2	8	20
Genesee	23.7	158	20
Hillsdale	..	2	20
Huron	1.5	6	20
Ingham	1.5	5	20
Jackson	4.5	14	20
Kalamazoo	1.3	56	18-20
Menominee	3.3	12	20
Minnesota—			
Washington	7	7	20
Missouri—			
Barton	8	21	18-20
Nebraska—			
Douglas	2	85	18
Platte	7	..	20
Sarpy	10	..	18-20
New Jersey—			
Cape May	6	..	20
Gloucester	5.7	55	20-40
New York—			
Albany	.2	.2	..
Erie	39	175	16-60
Herkimer	2.6	3.8	16-18
St. Lawrence	3.2	25.1	15-16
Suffolk	16.1	167.6	18-20
Sullivan	.5	6	16
Westchester	26.6	226	..
Ohio—			
Lake	6	..	20
Richland	3	71	16
Warren	3	..	..
Wood	4	21	16-22
Oklahoma—			
Bryan	3	..	18
Kay	2.5	30	18
Oklahoma (Continued)			
Kingfisher	6.3	23	18
Payne	2	7.8	18
Pittsburgh	..	50	18
Pottawatomie	14	40	..
Tulsa	5	210	18-20
Oregon—			
Multnomah	1	..	20
Pennsylvania—			
Lehigh	16.6	..	18-33
Mifflin	1.3	11	18
Schuylkill	6	90	18-30
South Carolina—			
Chester	21 S	21	18
Texas—			
Baylor	5.7	13	18
Dallas	35	75	18-40
Foard	15	15	18
Fort Bend	29	44	18
Freestone	23	52	18
Grayson	23	23	18
Hale	20	20	18
Madison	18.5	18.5	20
Matagorda	35	85	9-18
Randall	15.1	15.1	18
Webb	21 S	44	..
Utah—			
Utah	1	13	18
Washington—			
Pierce	6	173	16-18
West Virginia—			
Brooke	1	..	18
Wisconsin—			
Adams	1.5	3.5	20
Dane	21	144	20
Calumet	6.5	25	20
Manitowoc	20.4	68	20
Monroe	1.6	..	..
Richland	.5	12	16
Sauk	12	26	20
Sheboygan	30	97	20
St. Croix	8	34	20
Walworth	11.5	140	18-20
Waushara	13	39.5	20

Mountain	67,000
Pacific	365,000
United States	205,000

The counties in the various sections, of course, vary widely in area, population and mileage of roads; so that the last set of figures do not indicate the expenditure per square mile, per capita or per mile of road, but only average amount spent on road work by each county engineer together with the other county officials in charge thereof.



Map of the United States Showing Geographical Divisions Referred to in Article

Laying Cast Iron Pipe for intercepting sewer, Brittingham Park, Madison, Wisconsin

This *CAST IRON SEWER MAIN* is being laid for a century or more

The above photograph shows a large sewer job in Madison, Wisconsin which is being laid once and for all. The possibilities of future cost, future trouble and danger have been entirely eliminated by the specification of U. S. Cast Iron Pipe.

Cast iron, as every engineer realizes, is the most durable material known for underground sewer mains. It not only possesses great strength but it has a high resistance to corrosion. In fact, experiments have demonstrated that cast iron pipe is the only ferrous metal pipe which rust cannot destroy.

U. S. Cast Iron Pipe is made in strict accordance with established technical standard specifications. U. S. Pipe is carefully checked for quality and uniformity. Every length must pass severe hydrostatic and hammer tests before being approved by this company.

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Write for complete information about U. S. Pipe today.

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Prevention of Chloro-Phenol Tastes

Conclusions from study of superchlorination, ammonia and potassium permanganate treatments in three New York cities

IN 1929 the New York State Department of Health and the Department of Public Works of Buffalo, N. Y., conducted a joint study of the effectiveness of superchlorination, ammonia treatment and potassium permanganate treatment in preventing chlorophenol tastes. The results were stated by Charles R. Cox, assistant engineer of the State Department of Health, in a paper before the American Water Works Association. Describing the studies made at Buffalo, Rensselaer and Waterloo, he stated that the following conclusions were reached:

1. Superchlorination has been found effective, although the treatment is expensive. Superchlorination, however, has the great value of effectively disinfecting the water and of oxidizing some of the miscellaneous organic matter likely to be present in waters, thereby improving the general character of the treated water.

2. Ammonia treatment, when applied before the chlorine dose, is effective in preventing the formation of chlorophenol compounds. Successful results may be secured also by the mixture of ammonia and chlorine solution before they are introduced into the water to form dichloramine, which is a relatively stable disinfectant and does not appear to react with phenolic compounds. There is necessity of careful study of the effectiveness of chlorination of ammonia-treated water because it is known that chloramines are less active as disinfectants than corresponding quantities of chlorine, although the action of chloramines persists for longer periods, and thereby may have a greater ultimate effect. It would be dangerous, however, to apply ammonia treatment to heavily polluted waters unless preliminary study indicated that satisfactory disinfection is secured.

3. Potassium permanganate treatment is flexible, as it may be applied to either raw, filtered, or filtered chlorinated water. The necessary dose of 0.1 to 0.2 p.p.m. is low, and the cost of chemical of about $0.20 per pound is moderate.

4. Potassium permanganate treatment will not result in the staining of clothes, etc., judging from the experience at Rochester, Lackawanna, Waterloo and Rensselaer. It might be better, however, to treat the raw water, as at Rensselaer, so that insoluble manganese compounds will be removed.

5. Special care must be exercised, when utilizing the potassium permanganate treatment, to compensate for its influence upon the results of the orthotolidine test for residual chlorine.

Chlorination of Emergency Supplies

During the summer and fall of 1929, a large number of public water supplies were seriously depleted or failed entirely as a result of unusual drought in many sections of New York State. This condition necessitated the use of emergency supplies many of which were of questionable sanitary quality. In a number of instances, the engineers of the Division of Sanitation installed the emergency chlorination apparatus of the department for the treatment of such waters, rendering them safe for use. They also assisted in the installation of similar equipment purchased by various municipalities and supervised the construction of temporary plants for the disinfection of auxiliary supplies by means of hypochlorite of lime. The fact that there were no outbreaks of water-borne disease following the use of these waters is evidence of the effectiveness of chlorination and of the value of the work performed.

Airplane Landings in Mid-Ocean

Seadromes to be anchored between here and Europe. Test installation being built between New York and Bermuda

FOR any type of plane now developed or proposed, equipped for ocean flying, the economic flight range will not exceed 500 miles, according to Edward R. Armstrong in an address before the Engineers Club of Philadelphia and the Aero Club of Pennsylvania. Safe and economic airway operation between Europe and America necessitates the provision of landing points in the Atlantic Ocean. Mr. Armstrong proposes eight of such structures anchored to the bottom of the Atlantic at intervals of approximately 375 miles.

Holding a structure in position by anchors against the force of wind and waves in mid-ocean appears like an impossible proposition, but he states that a seadrome is not a ship, subject to the shearing and bending forces of large waves, but a deep-draft open-work structure constructed so as to permit the wind and waves to pass through it with practically no disturbance or loss of energy. Much of the displacement of the seadrome is in the relatively still water below the wave disturbance. Stability is insured by having the center of gravity below the center of buoyancy. Stream-line shape for the supporting columns, the deck and the deck housing, opposes minimum resistance to the wind. A full sized seadrome is being constructed for test and operation on an experimental airway between New York and Bermuda, at a point where the hydrographic department of the U. S. Navy has found a submarine plateau where the depth of water is only 12,600 feet.

The seadrome designed by Mr. Armstrong has a deck 70 feet above sea level, 1100 ft. long, and 340 ft. wide in the central section, with extensions on either side of the 180-foot central runway for hangars, restaurants, etc. This rests upon thirty-two buoyant chambers, attached solidly to and about 100 ft. below which are the same number of ballast chambers. Compressed air will be released about 160 ft. below sea level and the rising air bubbles will reduce a 30 ft. wave to a minor turbulence, giving a safety zone 250 ft. wide by 600 ft. long when necessary.

The anchorage cable system for the first seadrome, on the Bermuda route, was designed by John A. Roebling's Sons Co. It is 17,900 ft. long, made up in six sections varying in diameter from 3¾" at the surface to 2¾" at the bottom of the ocean, with a total weight of 325 tons and an ultimate strength in the surface section of 2,500,000 pounds. These cables are calculated to withstand the combined force exerted on

(Continued on page 100)

24" AND 30" VALVE INSERTIONS MADE UNDER FULL PRESSURE!

ESPECIALLY in the case of water mains as large as 24" and 30", it is no inconsequential matter to turn off the water pressure in order to install much-needed valves. The districts served by such mains are usually very large. The fire and health risks are great, especially since they can be avoided.

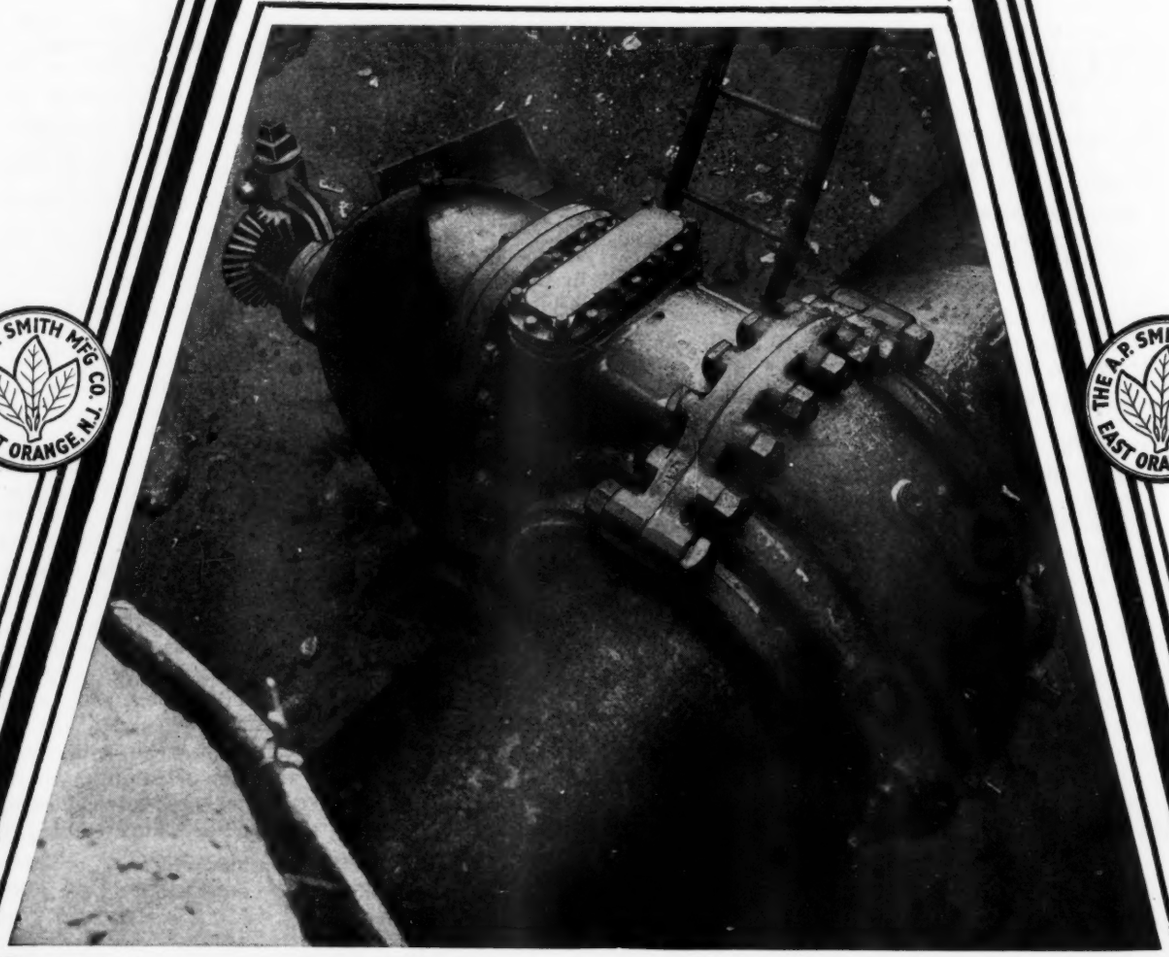
With the aid of Smith Valve-Inserting Machines, it is both an easy and a safe matter to make such large valve insertions when mains are under full water pressure every minute of the time. Such machines are of incalculable aid to waterworks departments.

The illustration shows a 24" horizontal-valve insertion. A new size Smith Inserting Machine, to handle 30" insertions, will shortly be on the market.

SMITH

WATER WORKS SPECIALTIES & SUPPLIES

THE A.P. SMITH MFG. CO. *East Orange, N.J.*



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THE A.P. SMITH MFG. CO. EAST ORANGE, N.J.

RECENT LEGAL DECISIONS

By John Simpson

TAR TANK USED IN REPAIRING HIGHWAY NOT A NUISANCE

In an action for injury, by an automobilist against a county and its agents, the plaintiff attempted to escape the well established rule of nonliability of a county for injuries caused by negligence in the construction and maintenance of public highways by charging that the defendants created a nuisance, by clouding the highway with smoke from a tar tank while repairing the road and obstructing free passage to vehicles, so that plaintiff, who was without warning of the dangerous condition, sprang from his car upon the hot tar and was injured. The Tennessee Supreme Court affirmed judgment for the defendants, Lee v. Davidson County, 13 S. W. (2d) 328, on the ground that it was not shown that the manner of performing the repair work was materially unusual or unnecessary, and the noise and smoke were sufficient warning to an observant person.

ACCORD AND SATISFACTION OF CLAIM AGAINST ROAD CONTRACTOR

A board of county road commissioners made four contracts with a road contractor for the construction of roads. In one the unit price for creosoted plank was $1.20 a foot. The contracts were completed and notes given for the balance due. Two weeks afterwards, the board concluded the price for creosoted plank was too high and was due to a mistake. The contractor put in a claim for extra work on the other jobs. Discussion was had, but no settlement of differences was arrived at. Finally the contractor sent the board a check containing the recital: "To balance accounts." The check was indorsed and cashed by the board. The board subsequently sued to recover the amount paid for creosoted plank above a unit price of 12 cents per foot on the theory that the amount was paid under a mistake. The Michigan Supreme Court held, Board of Road Comrs. of Midland County v. Midland Contracting Co., 247 Mich. 222, 225 N. W. 539, that when the board accepted, indorsed and cashed the contractor's check with the condition therein stated, there was an accord and satisfaction, and the differences between the parties were then and there settled. No fraud was charged, and the suit was not an equitable proceeding to reform an instrument on the ground of mutual mistake.

COUNTY NOT LIABLE FOR INJURY CAUSED BY EXCESS OF WIDTH OF ROAD OVER THAT OF BRIDGE UNDER GEORGIA STATUTE.

Under Georgia Civil Code 1910, §748, a county is not liable to a traveler on a highway for injuries resulting from a defect in the highway, but is liable to him only for injuries resulting from defects in bridges on the highway. The mere fact that a bridge, at its entrance on a highway, is narrower than the road, and as a result an automobilist, approaching the bridge and adhering to the outer edge of the road, will fall from the road into a declivity on the side of the road at the entrance to the bridge, constitutes no defect in the bridge itself, or in the abutments to the bridge, or in the manner in which the bridge is connected with the highway. The county, therefore, it is held, Knight v. Floyd County, Georgia Court of Appeals, 144 S. E. 348, is not liable for injury resulting from such an accident, since the danger is created, not by any defect in the maintenance of the bridge and its approaches, but solely by the excess in the width of the road over the width of the bridge, and the road's close proximity under such conditions to the declivity at the entrance of the bridge, all of which are independent of the construction and maintenance of the bridge and its approaches.

ROAD CONTRACTOR LIABLE FOR FAILING TO GUARD DANGEROUS FILL WHILE HE HAS ROAD IN CHARGE.

The North Carolina Supreme Court holds, Furlough v. Nash County Highway Commission, 196 N. C. 160, affirming 195 N. C. 365, 142 S. E. 230, that the liability of a road construction contractor for personal injuries caused by negligence in failing properly to guard a dangerous embankment, fill or cut, while the road along it was being reconstructed, subsisted as long as the contractor had the road in charge.

STATUTORY PROVISIONS FOR CONDEMNATION OF LAND FOR PUBLIC ROAD MUST BE FOLLOWED.

The .Nebraska Supreme Court holds, Shirley v Harlan County, 223 N. W. 284, that under the Nebraska statutes a county board has no jurisdiction to establish a public road when no commissioner has been appointed to examine into and report upon its expediency, unless the written consent of all the landowners whose land is sought to be taken for that purpose is filed with the county clerk. Where a statute requires that an attempt to agree with the owner shall first be made before the institution of condemnation proceedings to take private lands for public use, such provision is mandatory, and the condemnation proceedings are void if no such attempt is made.

COUNTY NOT LIABLE FOR INJURY FROM FALLING TREE UNDER STATUTE GIVING IT REGULATION OF ROADS.

The Alabama Supreme Court, Helms v. Houston County, 117 So. 633, holds that a county is not liable for the death of one driving a wagon on a public highway who was struck and killed by a dead or dangerous falling tree, due to the alleged negligence of the county board of revenue in failing to have it cut down, since Ala. Code 1923, § 1347, giving county boards general superintendence over county roads, does not impose liability on a county for damages for negligence, and no statute requires a county to remove dangerous trees liable to fall across a highway.

LACK OF COMPETITIVE ELEMENT IN CALL FOR BIDS

The Arizona Supreme Court holds, Berryhill Office Equipment Co. v. Phillips, 276 Pac. 4, that the failure of county supervisors to have the plans and specifications for the furniture and fixtures for a courthouse and county jail on file for inspection during the entire period of publication of the call for bids, 40 days, required by the statute, rendered the notice defective, where the advertised notice refers to specifications on file for the data necessary to inform the general public of what is wanted.

A Cast Iron main saves $70,000 for the City of PHILADELPHIA

Fairchild Aerial Surveys, Inc.

THE City of Philadelphia saved $70,000 by digging up an abandoned 48″ cast iron pipe line and relaying it in another location. This pipe line was originally put down in 1888. On examination it was found to be in excellent condition. Consequently the entire line was relaid in a new location where it is expected to serve for 75 or 100 years longer.

Cast Iron Pipe in large and small diameters has been serving the people of Philadelphia and saving them money for more than 100 years. A recent letter from the Chief of the Water Bureau states: "We have cast iron pipe laid in 1822 (8″) and 1827 (6″), both of which appear to be in good condition."

The reason why Cast Iron pipe serves for centuries is because of its effective resistance to rust and corrosion. Gas and water mains of ferrous metal (iron and steel) with the exception of *cast iron* disintegrate from rust. Cast Iron pipe is the only ferrous metal pipe practicable for underground mains which rust will not destroy.

Engineers, contractors and city officials desiring detailed information on the efficiency and economy of Cast Iron pipe for water and gas mains, sewers, road culverts or industrial uses are invited to write to The Cast Iron Pipe Research Association, Thomas F. Wolfe, Research Engineer, 309 People's Gas Building, Chicago, Ill.

The "Q-check" symbol shown above has been adopted as the trade mark of The Cast Iron Pipe Research Association.

CAST IRON PIPE

Cast iron pipe bearing the "Q-check" trade mark is obtainable from the following leading pipe founders: Alabama Pipe Company, Anniston, Ala.; American Cast Iron Pipe Company, Birmingham, Ala.; James B. Clow & Sons, 219 N. Talman Avenue, Chicago, Ill.; Donaldson Iron Company, Emaus, Pa.; Glamorgan Pipe and Foundry Company, Lynchburg, Va.; Lynchburg Foundry Company, Lynchburg, Va.; National Cast Iron Pipe Company, Birmingham, Ala.; United States Pipe and Foundry Company, Burlington, N. J.; Warren Foundry and Pipe Company, 11 Broadway, New York.

For latest catalogs — consult the *classified* INDUSTRIAL LITERATURE section, pages 133 to 140.

A call for bids for material, naming a definite fixed sum available therefor and requiring the bidders to bid that amount, no more, no less, based alone on quality and design, is held to eliminate the competitive element of price, and to defeat the provision of the statute requiring that the contract be let to "the lowest and best responsible bidder."

A provision of the specifications requiring bidders to submit a list of three similar buildings furnished was held unreasonable as tending to stifle competition.

LIABILITY FOR BENDING FENCE BY PILING MATERIAL AGAINST IT

Where a county contracts for the doing of construction work according to plans and specifications theretofore adopted, and the contractor performs the work with proper care and skill, and in conformity with the plans and specifications, but the work thus planned and specified results in an injury to adjacent property, the California courts hold, Northwestern Pac. R. Co. v. Currie, 279 Pac. 1057, that the liability, if any there is, for the payment of damages is upon the county under its obligation to compensate the damages resulting from the exercise of the governmental power; but where the contractor departs from the contract, plans or specifications, or goes beyond them, or performs the work planned and specified in an improper, careless or negligent manner, which results in injury to adjacent property, then he is responsible for the tort he has committed. The injury complained of was the bending of a railroad right of way fence by piling material against it. The specific acts of negligence causing the injury were alleged by plaintiff not to be such as defendant contractor was required to perform under the contract. As the trial court found these allegations to be true and the appellate court had nothing to show to the contrary because the plans and specifications were not made part of the record, judgment for plaintiff was affirmed.

EXECUTED ROAD CONTRACT NOT NECESSARILY VOID BECAUSE COUNTY COMMISSIONER INTERESTED THEREIN

The Washington Supreme Court holds, O'Connor v. Murray, 278 Pac. 176, that a taxpayer could not have a road contract declared void because a county commissioner was beneficially interested therein, where the work was done by the contractor, accepted by the county and state, the reasonable value of the work done equaled or exceeded the contract price, the county commissioners were actuated by the best of motives, and the results obtained were highly beneficial to the county.

APPORTIONMENT OF COST OF PAVING COUNTY HIGHWAY PASSING THROUGH CITY

Where a county has been maintaining a public highway through a city, and the city desires to pave it and the county is willing to contribute thereto, it is permissible, under the Mississippi law, for the county and city to agree upon paving the highway, each contributing a part of the expense thereof. But where the county paid the city 40 per cent for this specific purpose, it is held, City of Laurel v. Fox, 122 So. 484, that this became a trust fund in the hands of the city for the benefit of all the abutting owners, to be applied in the reduction of their assessments in accordance with the apportionment made in the original assessments.

ASSIGNMENT OR SUBLETTING OF GOVERNMENT PUBLIC WORKS CONTRACT

A clause in a government public works contract, which is substantally that of U. S. Rev. St. § 3737, that neither the contract nor any interest therein shall be transferred to any other party or parties, and in case of such transfer the United States may refuse to carry out the contract either with the transferrer or the transferee, is held to be for the benefit of the government, which may or may not, at its option, permit an assignment of a contract originally let. It is the duty of both parties to an assignment or subletting of such a contract to use their offices and influence to procure consent to the assignment or subletting, and neither will be permitted to set up nonassignability without the consent of the government, unless he has done what was in his power to procure such assignment.—Mullen & Junkin v. Byrd & Clopton, Mississippi Supreme Court, 122 So. 485.

OUTSTANDING CLAIMS BARRING CONTRACTOR'S ACTION FOR BALANCE OF CONTRACT

Judgment for defendants in an action against a state highway commission and state treasurer for balance of a bridge construction contract was affirmed where (a) the balance of the contract price was not due at the commencement of the action because of outstanding filed claims, the existence of which barred payment under the contract, and (b) the extra work on a counterweight was due to an error for which either the contractor was responsible, or the highway engineer had not been shown to be responsible.

The commission represents the state, and a suit against the state treasurer in his official capacity has been held a suit against the state. Whether such an action would lie on a disputed claim was not decided, the point not being raised.—Union Indemnity Co. v. State Highway Commission, New Jersey Court of Errors and Appeals, 146 Atl. 206.

WARRANTY AS TO SEPTIC TANKS

Where septic tanks and cesspools were installed under a contract providing that the contractor should furnish labor and materials required for the installation according to specifications which required a tank to receive waste, it was held there was no implied warranty that the device would function satisfactorily in the place it was installed so as to render the contractor liable where the tanks would not function due to the surrounding soil and, while they received the waste, they did not dispose of it.

SUFFICIENT DESCRIPTION OF MATERIALS IN PAVING ORDINANCE

The Alabama Court of Appeals holds, Cabaniso v. City of Huntsville, 118 So. 494, that an ordinance providing that a driveway should be paved with asphaltic paving, sheet asphalt paving, Warrenite bitulithic paving, one course Portland cement concrete paving, vertical vitrified brick paving, asphalt filled, Tarvia double-seated paving, or Willite sheet asphalt, with specifications as to each, the final selection of the type of paving material being reserved by the council, was not objectionable as failing to describe the general character of the materials to be used for the improvement, as required by Ala. Code 1923, § 2176.

Builders of Industrial Empire

INTERNATIONAL

One of a fleet of Heavy-Duty Internationals working on Pennsylvania Railroad widening, between Washington and Baltimore

Since 1919, beginning with an output already impressive, International Harvester truck production has increased seven-fold, while the total production of the truck industry has only doubled. The International Truck Line includes the Special Delivery, the Six-Speed Special, Speed Trucks to 3-ton, and Heavy-Duty Trucks to 5-ton.

EMPIRE BUILDERS of the new order . . . *International Trucks!* Once the railroads held sole title to the term, as they forced back the wilderness, but now the heavy-duty motor truck disputes the claim.

Indeed, while the railroads still build empire *the trucks are building railroads.* Granted that the great pioneer trunk lines were laid before the birth of the truck, today the truck is indispensable where new projects face the construction engineer.

Problems of the 'Sixties and 'Eighties somehow found their slow and painful solution, *but the truck is of today and tomorrow.* With its flexible power and efficiency the mountainous labor of load-distribution is infinitely simplified.

The McCORMICK-DEERING Industrial Tractor

A compact, economical power unit ready for most anything. It delivers its power three ways . . . through drawbar, belt, or power take-off. It pulls, pushes, and lifts. It combines with an almost endless variety of equipment. Write for the booklet, "Tractor Power in Industry."

INTERNATIONAL HARVESTER COMPANY
606 So. Michigan Ave. OF AMERICA (*Incorporated*) Chicago, Illinois

Here is a McCormick-Deering Industrial Tractor performing its simplest service—hauling trailers at the drawbar

For latest catalogs — consult the *classified* INDUSTRIAL LITERATURE section, pages 133 to 140.

RIGHT TO PAVE STREETS BEFORE MAKING GAS, WATER AND SEWER SERVICE CONNECTIONS.

Minneapolis City Charter, section 1, c. 9, provides: "The city council shall require, before any street is paved, that the gas, water and sewer pipes be laid therein and connections made with the front line of each lot." A lot owner sued the city to prevent the repaving of a portion of an avenue, one ground being that the service connections with gas, water and sewer had not been made as required by the charter. The Minnesota Supreme Court held, Freding v. City of Minneapolis, 224 N. W. 845, that the quoted provision is merely directory and not mandatory. It is not an integral part of the grant of power to pave streets. The use of the word "shall" is not decisive. The purpose must have been to prevent, as far as reasonably possible, the necessity of tearing up the pavement for the purpose of making service connections. In this case the city alleged that in the repaving connections were being extended to the curb line, so that when connections were later made it would not be necessary to destroy the pavement to make them; and that the city was making all necessary connections as required by the abutting owners.

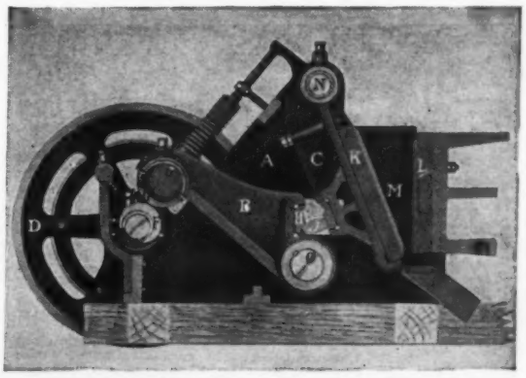
The action of the council in ordering brick pavement at a cost of $5.50 per square yard, instead of resurfacing at 70 cents per square yard, was held not arbitrary nor unreasonable.

PROPOSED MUNICIPAL CONTRACT HELD VOID BECAUSE IN EXCESS OF APPROPRIATION.

The Nebraska Supreme Court holds, Moore v. Central City, 224 N. W. 690, that the city council of a city of the second class cannot incur any expense or enter into any contract on behalf of the city unless an appropriation shall have been previously made concerning such expenditure, except in cases where the proposition has been sanctioned by a majority of the legal voters of the city. Applying this rule, it was held that where the defendant city, pursuant to an election held under the statute, was empowered to enter into a contract for the repair of the city hall building and to transfer a sum "not to exceed $10,000" for this purpose from an electric light fund, and bids were submitted and a contract was let to the lowest bidder for $10,540, the proposed contract was illegal and void, and no lawful contract could be entered into between the parties for a greater amount than $10,000.

BOARD'S DUTY TO ASCERTAIN LOWEST RESPONSIBLE BIDDER

The Pennsylvania Supreme Court holds, Schuck v. School District, 146 Atl. 24, that the language of a statute providing that school building construction shall be under a contract with the lowest responsible bidder is mandatory, not discretionary, and if there is more than one responsible bidder, the work can be authorized only under contract with the lowest. In an action to enjoin the putting into effect of a school building construction contract, the trial court's finding that no investigation was made by the school board to ascertain the responsibility of the lowest bidders except two was accepted as correct on appeal, where there was ample evidence to sustain the finding. The court said that the discretion vested in public officials in the making of contracts requiring the expenditure of public money is not unbridled, but must be a sound discretion, exercised according to the standards fixed for the protection of the public; and that, as distributors of public money, they cannot act as they might do if expending their private funds.



The Lever Type Crusher Is the Best in the Long Run

IT will pay you to investigate the "RELIANCE" with its—

LONGER LEVER
OVERSIZE BEARINGS
FORCE FEED GREASE LUBRICATION

and many other superior features.

Complete crushing, screening and washing plants in all capacities from 50 to 1500 tons per day.

Write for catalog and prices

Universal Road Machinery Co.
KINGSTON, NEW YORK

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Broadway at Sixty-Third Street
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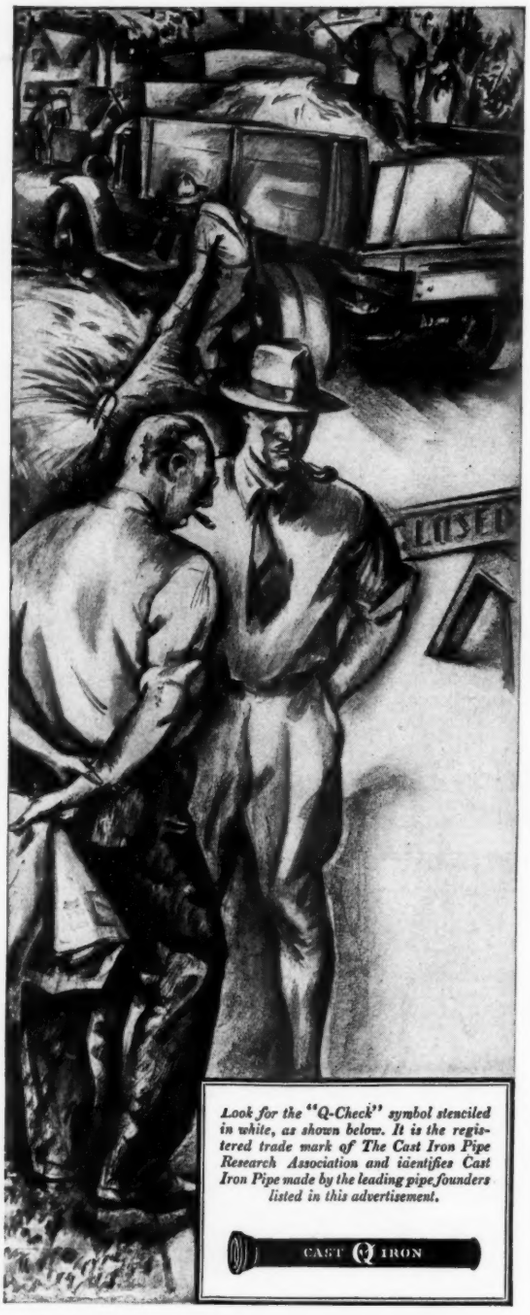
In the heart of the Automobile District

A new fourteen-story fireproof structure. Unique location—ten minutes from forty theatres and near all places of interest. Subway, elevated, buses all at door.

Room with private toilet, $2.50.
Room with private bath, $3.50.
Double room with private bath, $5.00.

M. P. MURTHA, General Manager



Look for the "Q-Check" symbol stenciled in white, as shown below. It is the registered trade mark of The Cast Iron Pipe Research Association and identifies Cast Iron Pipe made by the leading pipe founders listed in this advertisement.

CAST Q IRON

...and how about the Fire Hydrants---will they last as long as the pipe*

**With Acknowledgement to the Cast Iron Pipe Research Bureau*

Are the castings for the fire hydrants free from strains? Are they proof against leakage? Will they withstand the high pressure of the mains? Will they function smoothly at a moment's notice no matter when the emergency comes?

And . . . will they last as long as the pipe?

There is one way to be sure. Check the record of COLUMBIAN Hydrants . . . especially in the towns where they have been on the job ten, fifteen or more years.

That service record goes back to certain unusual facts. All castings for COLUMBIAN Hydrants, for instance, are cured slowly to prevent shrinking, warping and internal strains . . . and that means perfect, permanent alignment of the valves. All threads and contact surfaces are machined to standard steel gauges . . . that means parts of identical dimensions can be replaced at any time. All moving parts can be removed through the top without digging up the hydrant. And you can lubricate a COLUMBIAN hydrant as easily and as quickly as you lubricate your car.

These features, all of them, have a direct bearing on that vital question: Will the fire hydrants last as long as the pipe? May we mail you list of nearby users and a copy of the Columbian folder? The coupon, posted now, will bring it!

Columbian Iron Works,
Chattanooga, Tenn.

Gentlemen: Please send me a copy of the Columbian folder and list of users in this territory.

Name .....

Address .....

City .....

PW 5-30

Columbian
IRON WORKS
CHATTANOOGA, TENNESSEE

Dredges and Draglines on Levee Construction

(Continued from page 27)

Sauerman Bucket and Dragline. Nearly Finished Levee at Left

draglines. For this work, under present conditions, three such machines working in a team are ordinarily required. First a large machine travels parallel to the levee line and about 160 feet from the toe of the levee on the river side, throwing up a pile of dirt from a borrow pit. Following this machine, another dragline with an extra long boom throws up the levee from the dirt provided by the first machine, and where necessary supplements it with additional material from that section of the borrow pit which it can reach. This machine is not able to complete the levee section, as it cannot reach beyond the crown of the levee. A third small machine, working on the levee, or on the landside toe, is required to complete the work and bring the levee to approximate grade and section.

There are some sections where haul-in work by teams is necessary, as at the junctions with the old levees, where sufficient fill is not available within reach of the dragline teams. Much of this work has been subcontracted by J. J. McCaughey Construction Co., which is hauling in with mules and with tractor-trailer teams and Linn tractors. Mr. McCaughey has used a variety of equipment to load his wagons and trucks. He has a power shovel, which has done excellent work; a dragline; and two elevating graders. With these he loads into his outfits, for a haul of about 500 to 800 feet.

The 16-inch dredge began work at the lower end of the job, on contract 8E. One 12-inch dredge started at the north end. About the middle of November, the job being somewhat behind schedule, another 12-inch dredge was put in service about midway of the other two.

At a section at the extreme south end, a F. B. diesel-powered tower machine is being employed for finishing the levee in place of the draglines. This machine, which was built by Sauerman, has a reach of about 600 feet and is equipped with a 6-yard Sauerman bucket. This piece of equipment has been worked principally with the tail tower mounted on a barge operating in the borrow pit resulting from the hydraulic dredge operation. The working conditions have been very difficult, due to soft ground and other operating difficulties, and comparatively little dirt has been moved.

Other Equipment

In addition to the tower machine and the dredges, the contractor has used a variety of dragline equipment, including one 3-yard Page diesel-powered machine with a 73-foot boom; one 2½-yard Page, otherwise similar; one 2-yard Page with a 60-foot boom, also diesel-powered; two Link-Belt 1-yard draglines, diesel-powered, with 50-foot boom; one P & H dragline, diesel-powered, with 50-foot boom; one Bucyrus steam dragline, with a 5-yard bucket and 115-foot boom; and one Page steam dragline, with 4-yard bucket and 115-foot boom. All of the diesel equipment mentioned is made by Fairbanks-Morse.

On the hauling work, J. J. McCaughey Co. has a 1¼-yard Northwest dragline, a 1-yard Northwest shovel, six Caterpillar "60" tractors, eight Austin 7-yard crawler wagons, about twenty mule teams, and two 100 h.p. Linn tractors equipped with 6-cylinder Waukesha motors and carrying 5-yard dump bodies. These Linns have been exceedingly handy, not only in straight hauling, but in working in places too close for economical operation of the tractor-trailer teams, and for extra work where comparatively small quantities of dirt have to be moved, as in bringing low spots to grade. There are also two excavating graders, both Austin, one of which is equipped with a power take-off.

Personnel

The work in the Reelfoot district is under the general direction of the First Field Area of the Memphis Engineer District. Assistant Engineer W. A. Steele has supervision of the work, which is directed by H. T. Slade, with headquarters at Hickman, Ky. Inspectors on the work are as follows: Contract 8A, C. A. Bogert; 8B, C. H. Andrews; 8C, J. B. Cato; 8D, B. S. Davies; 8E, W. P. Clark. For the contractors, both Mr. Sweet and Mr. Price are on the job most of the time, as is their superintendent, Mr. Thomas.

Return Water Carried Through Old Levee in Flowing Back to Borrow Pit

Columbus Automatic Lock Top Manhole Cover

Patented October, 1928

Has many advantages and features over the old style manhole

1. SAFETY—Like your home, it opens in a special manner. Children cannot remove the lid and fall in as often as the old style manhole.
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Sewerage Systems and Plants Built in 1929

(*Continued from page 44*)

growing area and bathing beach. It comprises bar screens, 2 septic tanks, 18,000 gal. dosing chamber, and 1.38 acres of intermittent sand filters.

Massachusetts: No new sewage disposal works were constructed in this state in 1929.

The sewerage works for the South Essex Sewerage District, having an outlet into the sea, begun in 1926 were completed in 1929.

New Mexico: The town of Grants built an Imhoff tank (no secondary treatment) the effluent discharging into the river.

South Dakota: Armour completed plant comprising Imhoff tank, trickling filters and final settling tank.

Texas: New sewerage systems were built by Mabank, Grandview, Midland, Milford, Shiner, Matador, Silverton, Kenedy, Falfurrias, Sabinal, Higgins, Goree, Halletsville, Snyder, Karnes City, Quitaque, Asherton, Valley Mills, Frankston, Lorenzo, Waelder and O'Donnell.

Treatment plants were built as follows; Imhoff tank and sludge bed at Silverton, Snyder, Karnes City, Quitaque, Frankston and O'Donnell.

Imhoff tank, hypochlorite and sludge bed at Mabank, Grandview, Lorenzo and Waelder.

Imhoff tank, chlorine and sludge bed at Milford and Higgins.

Imhoff tank, sludge bed and Dunbar filter at Itasca, and the same with chlorination added at Shiner.

Imhoff tank, sludge bed and broad irrigation at Midland, Matador, Falfurrias, Sabinal; and the same with hypo, at Goree.

Imhoff tank, sludge bed and sprinkling filter at Kenedy, Halletsville, and the same with chlorine at Asherton and Valley Mills.

Imhoff tank, activated sludge and irrigation at Coleman.

Imhoff tanks, screens, activated sludge, settling tanks, separate sludge digestion and sprinkling filters at Fort Worth.

Aeration, settling, clarification and sludge beds at San Antonio.

For the above information we are indebted to the following: Delaware—R. C. Beckett, state sanitary engineer. Indiana—Lewis S. Finch, chief engineer, Dept. of Sanitary Engineer, State Board of Health. Maryland—Abel Wolman, chief engineer, Department of Health. Michigan—Edward D. Rich, director, Dept. of Health. Mississippi—H. A. Kroeze, director, Bureau of Sanitary Engineering, State Board of Health. North Dakota—A. L. Bavone, director, Bureau of Sanitary Engineering, Dept. of Public Health. Oklahoma—H. J. Darcey, state sanitary engineer. Rhode Island—Stephen DeM. Gage, sanitary engineer, Public Health Commission. South Dakota—W. W. Towne, director, Division of Sanitary Engineering, State Board of Health. Texas—V. M. Ehlers, director, Bureau of Sanitary Engineering, State Dept. of Health.

Virginia Bridge Authority Proposed

The Virginia Legislature has before it a proposal known as the Jeffreys "Virginia Bridge Authority" measure, which would create the Virginia State Bridge and Tunnel Commission and give to such body the authority to bond itself for the purpose of acquiring or constructing a bridge or tunnel connecting the cities of Norfolk and Portsmouth. Bonds would be payable solely out of revenues and bear interest at rate not exceeding 7%.

Drainage in Airport Design

(*Continued from page 25*)

determines the possibility of subdrainage, the relative amount of ground water runoff and the proper spacing and depth of subdrains.

The maximum rate of subsurface runoff during rainy weather depends largely upon the soil type and its structure, and is limited by the ability of the soil to allow the passing of water through it, which is known as the soil's permeability. It is recommended that a minimum of ½ inch runoff per 24 hours be used in airport subsurface design. This factor may be increased to ¾ inch or even to 1 inch in regions of exceptionally heavy rainfall and where more pervious soils are encountered. A runoff of ½ inch per 24 hours is equal to 0.021 cu. ft. of water per second per acre.

The proper depths and spacing of subdrains to secure the desired results is dependent upon the drainage characteristics of soils; hence a thorough study of soil properties is in every case essential. Soil characteristics, their determination, and their effect upon the drainage design, is a broad subject and can only be touched upon in this short article. Much information has been published on soils and the subject of land drainage which can be applied to the airport drainage problem.

Analysis of Soils.—Texture and structure are the terms in common use to denote the physical character of a soil. Texture refers to the size, or range of sizes, of the individual soil grains, while structure is used to describe the manner in which the individual particles tend to cling together or group themselves into granules or clusters. Texture may be determined by a mechanical analysis; but, unfortunately, there is no standard method of determining the structure of a soil except by the indirect one of predicting its probable structure from a knowledge of its texture. From the standpoint of permeability, structure is fully as important as the soil's texture, if not more so. The perviousness or permeability of a soil is a measure of its ability to allow liquids or gases (usually water or air) to pass through. This depends upon both the size and the hydraulic efficiency of the channels formed by the connected pores in the soil.

The many soil tests, both laboratory and field, which have been proposed are merely attempts to secure data which are indicative of the probable behavior of a soil in the field. The presence of worm holes, root cavities, etc., which may have a pronounced effect on the soil's permeability, cannot be taken into account in laboratory tests. A great need exists for the development of a simple field method to measure directly the permeability of a soil in its undisturbed state.

In the absence of a better and a more scientific, yet workable method of determining the proper depth and spacing of subdrains, a mechanical analysis plus field observations will usually furnish sufficient data for the design.

Soils have been classified, by the U. S. Bureau of Soils, according to their texture, as shown in Table No. 1. Each soil class is determined by the percentage and size of individual soil grains contained therein. Soil grains have been arbitrarily classed according to their size into three groups, namely: sand, silt, and clay. To eliminate confusion in names, these groups are designated as soil separates. The size or diameter of the soil grains in each soil separate is as follows:

Larger than .05 mm	sand or gravel
.05 mm to .005 mm	silt
Smaller than .005 mm	clay

The determination of the percentages of soil separates contained in a soil is known as a mechanical analysis.

Test holes should be bored or excavated at representative points on the field to depths of 4 to 6 feet, or until an impervious stratum is encountered. Soil samples should be procured of each soil stratum encountered, and its top and bottom depths carefully noted, and the relative rate of infiltration of ground water observed. From a mechanical analysis of the soil samples, the soil can be classified as shown in Table No. 1, and a soil profile plotted of each test hole as shown in Figure No. 8. In this way the character of the soil to be encountered in each part of the field, together witih the elevation of the water-table, can be seen at a glance. Such a record may be of considerable value in checking the system's efficiency in the future.

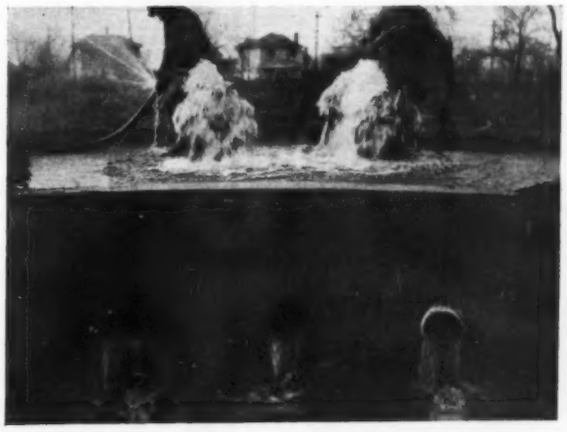

Fig. 6—Making Test With Two Fire Hose Working Full Capacity, Which Was Not Sufficient to Flood Tract; Trenches Were at No Time Full of Water

Fig. 7—Effort to Determine Maximum Capacity of Gravel and Drains. Each Line of Pipe Was Reduced to 6 Ft. Long and Upper Ends Plugged. A Weir Was Constructed So That Water Would Be Evenly Distributed Over Tract. Same Amount of Water as in Fig. 6, But Trenches Still Not Full of Water. Each Pipe Flowing About Quarter Full

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Assuming that the soil's permeability decreases as the percentage of silt and clay separates increase, under normal conditions, the soil classes shown in Table No. 1 may be considered to be listed in the order of their relative permeability. In order to make the spacing of subdrains as rational as possible, the schedule of depths and spacing is tentatively suggested.

Table No. 1
Recommended Depths & Spacing of Subdrains For Various Soil Classes

Soil Classes	Percentage of Soil Separates Sand	Silt	Clay	Depth to Flow Line of Drain	Distance Between Subdrains
				3-4 ft.	150-300 ft.
Sand	80-100	0-20	0-20	2-3 "	100-150 "
				3-4 "	100-150 "
Sandy loam ..	50-80	0-50	0-20	2-3 "	85-100 "
				3-4 "	85-100 "
Loam	30-50	30-50	0-20	2-3 "	75-95 "
				3-4 "	75-85 "
Silt loam	0-50	50-100	0-20	2-3 "	65-75 "
				3-4 "	65-75 "
Sandy clay loam	50-80	0-30	20-30	2-3 "	55-65 "
				3-4 "	55-65 "
Clay loam	20-50	20-50	20-30	2-3 "	45-55 "
				3-4 "	45-55 "
Silty clay loam.	0-30	50-80	20-30	2-3 "	40-45 "
				3-4 "	40-45 "
Sandy clay	50-70	0-20	30-50	2-3 "	35-40 "
				3-4 "	35-40 "
Silty clay	0-20	50-70	30-50	2-3 "	30-35 "
				3-4 "	30-35 "
Clay	0-50	0-50	30-100	2-3 "	25-30 "

Because of unusual soil conditions, it is sometimes impractical to strictly follow Table No. 1. The best practice regarding the spacing of subdrains will result from a scientific analysis of previously designed fields.

The depth of subdrains is sometimes limited by the available outlet or by the fact that an impervious stratum, such as hard pan, lies close to the surface. In most soils, subdrainage under sod areas should be 3 to 4 feet deep to be efficient and economical, even though pumping must be resorted to. For the subdrains to prevent frost action under pavement and surfaced areas, the depth should be such that capillary water will not rise from the water-table in the soil to the pavement base. Table No. 2, from the Department of Soil Technology, Cornell University, shows how soil texture affects capillarity.

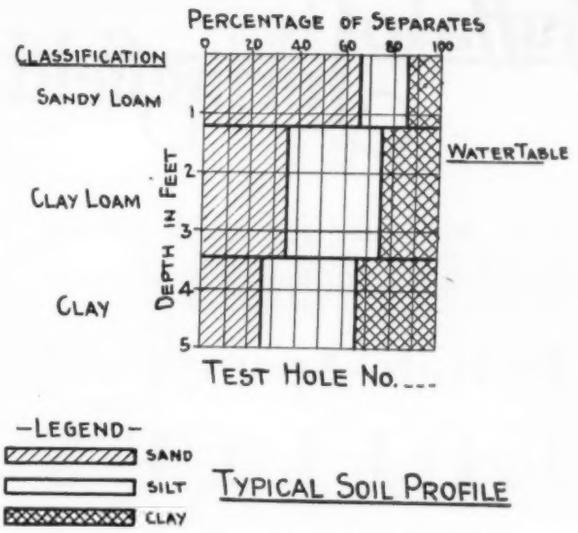

Fig. 8—Typical Soil Profile at Test Hole

TABLE NO. 2
EFFECT OF TEXTURE ON RATE AND HEIGHT OF CAPILLARY RISE FROM A WATER-TABLE THROUGH DRY SOIL

Soil	1 hour	1 day	2 days	3 days	4 days	5 days
	Rise Inches	Rise Inches	Rise Inches	Rise Inches	Rise Inches	Rise Inches
Sand ..	3.5	5.0	5.9	6.8	6.8	6.9
Clay ...	0.5	5.7	8.9	10.9	12.2	13.3
Silt ...	2.5	14.5	20.6	24.2	26.2	27.4

The Required Strength of Drain Pipes

Drain pipes under landing fields are subject to great loads. Engineering practice obligates the designer of any structure to provide for the maximum load multiplied by a factor of safety.

(Concluded on page 90)

Table No. 3
Minimum Safe Depth of Cover in Feet for Rigid Pipes Based on a 30,000 lb. Surface Load

Diam of Pipe in Inches	Length of Section in Feet	Farm Drain Tile	Standard Drain Tile	Extra Quality Drain Tile	Cement Concrete & Clay Sewer Pipe (Double Strength)	Stand. Reinf. Concrete Pipe (2000 D)	Ex. Strength Reinf. Conc. Pipe (4000 D)
6	1	5.5	3.5	2.8	..	..	..
6	2	..	..	..	3.0	..	..
12	2	Not safe*	Not safe	4.8	4.4	2.4	1.5
12	3	..	..	..	4.3	2.2	1.2
12	4	..	..	..	..	2.0	**
18	2		Not safe	Not safe	Not safe	2.7	1.6
18	3		..	..	Not safe	2.5	1.2
18	4		..	..	..	2.2	**
24	2		Not safe	Not safe	5.0	3.0	1.7
24	3		..	..	5.0	2.9	1.4
24	4		..	..	..	2.6	**
30	3		Not safe	Not safe	Not safe	3.0	1.3
30	4		..	..	..	2.7	**
36	3		Not safe	Not safe	Not safe	2.9	1.0
36	4		..	..	..	2.5	**
42	4		..	..	..	2.4	**
42	6		..	..	..	**	**
48	4		..	..	..	2.1	**
48	6		..	..	..	**	**

Not permitted

Notes:

Spaces left blank indicate that pipe is not generally available in the length of section indicated.
*"Not safe" means for depths of cover of 5.0 feet or less. The maximum safe depths of cover are not shown here.
**Theoretical safe depths are less than 1 foot. A minimum depth of cover of 1 foot is recommended in any case.

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Airport Drainage

(Continued from page 89)

The total load on a drain pipe is composed of the dead and the live load. The dead load is that load due to the ditch-filling material and can be computed as outlined in Iowa State College Bulletin 47. The live load is that part of the surface load which is transmitted through the filled material.

It is predicted that planes weighing 30,000 and probably 40,000 lbs. will be in use in the very near future. Many are of the opinion that these large planes are necessary before air passenger service will pay.

The surface load produced by a truck moving at 15 miles per hour, according to Iowa State College Bulletin 79, may be from 1½ to 2 times the truck's dead weight. Therefore, an impact factor of 2 for heavy airplanes would seem to be very conservative.

Assuming a plane weighing 30,000 lbs. and an impact factor of 2, the surface load under each wheel would be 30,000 lbs. Based on this surface load, the live load on various sized pipe under any cover can be figured as outlined in Iowa State College Bulletin 79.

Regarding the safety factor to be used in rigid pipe design, the following is quoted from Iowa State College Bulletin 47, page 27:

> A study of all known cases of cracking of sewer pipe or drain tile in actual ditches, and of the detailed data of a large number of cases of sound pipe in ditches, shows that a safety factor of 1-½ is both necessary and sufficient to prevent cracking.

Based on the total load computed as outlined above, multiplied by a safety factor of 1½ (except for the reinforced concrete pipe), Table No. 3 has been compiled to show the minimum safe depth of cover to prevent rigid pipe airport drains from cracking. Only pipe complying with the standard specifications of the A. S. T. M. and the "Joint Concrete Culvert Pipe Committee" has been considered.

It has been amply demonstrated both in the field and in the laboratory that corrugated metal pipe will support, with perfect safety, loads much heavier than those encountered by airport drains. Railroads are using it for shallow drains under tracks where severe impact loads are encountered as well as for large diameter culverts under fills up to 100 feet in depth. The strength of corrugated metal pipe has been explained by extensive tests made by Dean Anson Marston and his associates at Iowa State College, as well as by later tests made by the American Railway Engineering Association, and the University of North Carolina.

Conclusion

Good drainage will promote safety for air transportation and will increase the earning capacity of the airport. The design of the drainage system must be based upon the local conditions, the plan of the airport, and the results desired to be obtained. Airports require a superior type of drain pipe because, in the case of surface intercepting drains, the pipe is required to function under a head and because of heavy loads.

Southern California's Water Resources

A general underground water investigation of the entire Pacific slope of southern California is nearly completed. Well records over several years on 968 wells have been obtained by the state itself or furnished from other sources, and all these data are being compiled into a report, which together with maps will be published at an early date.

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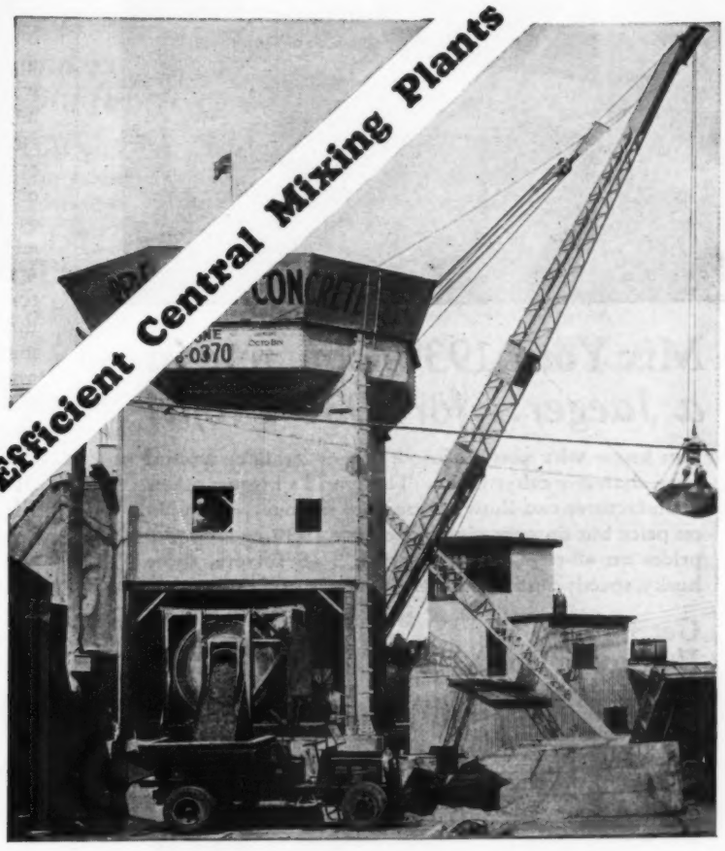

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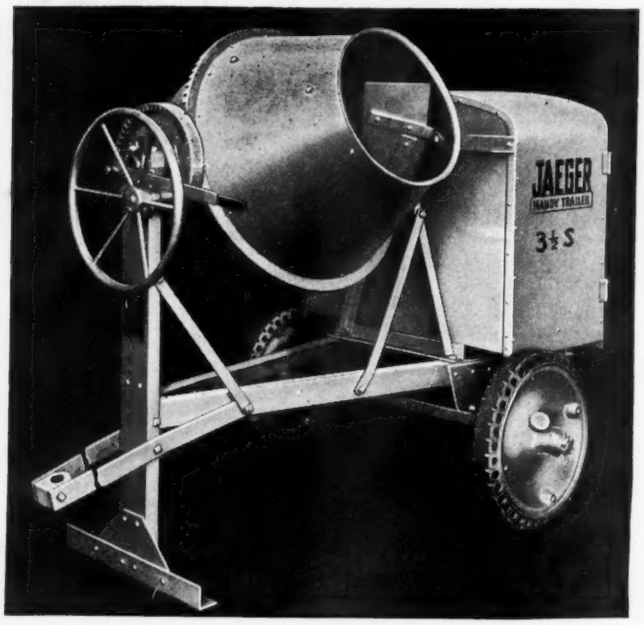

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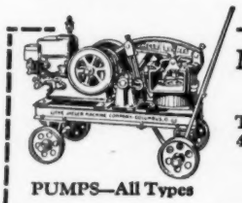

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(*Continued from page 20*)

the best and most economical practice to be to make two very light applications, one as early in the spring as practicable and as the weather conditions will permit, and the second as late in the fall as will allow the work to be done properly and well cared for.

In the spring application, we apply from one-tenth to one-eighth of a gallon of either asphalt or tar to the square yard, filling this with screened sand, using only such an amount as will keep the traffic from slipping and the bitumen from seeping off the surface. The hones are started dragging the green or fresh bitumen as soon as possible after application or when not more than a half mile has been covered, although at times it may be desirable to give the bitumen a chance to penetrate the old surface, especially where this has become corrugated. Our experience, however, has been that it is more dangerous to wait too long after the application than to start the drags too soon.

If the surface is broken or rough, it is necessary at times to put one or two tons of weight on each drag in order to obtain the cutting effect necessary to shave off the bumps and corrugation. It is surprising to find how quickly the old surface will become softened with the application of hot bitumen and how easily the heavy drags will shear off the bumpy spots and uneven surfaces, and how cheaply this can be done by a trained crew. The drags, preferably working in pairs, start on the outer edges and work the material to the center of the travelled section, and then back to the outer edge, and again back to the center; repeating this operation as many times as are necessary to shave off the bumps. When the mulch which has been worked up by this operation begins to stiffen, an inspection is made of the surface to ascertain whether all the bumps and corrugations have been cut off. When this has been effected, the weight is taken from the drags and they continue moving the mulch over the surface to fill all the depressions which cannot be cut out by the weighted drags. We have yet to find any material which is better suited for filling the depressions than this mulch which is worked up on the surface of the road by the drags.

After the surface has been gone over by the drags without weight, all loose and excessive material is pushed off the surface by the drags onto the shoulders, and in many cases is smoothed down there, thus building up a smooth waterproof shoulder surface and increasing the riding width from 4 to 8 feet.

The entire surface is then given a light dusting of fine sand, just enough to keep the bitumen from picking up under traffic and to allow the material to cure and remain in as plastic a state as possible; for we have found that excessive sanding destroys the life of the bitumen.

After this spring application of bitumen, dragging is continued during the heated season of summer or whenever the roads show a tendency to become rough through slipping of the top or from excessive bitumen which was not removed at the time of application. This moves any excessive bitumen into any low places that may have been formed under the weight of traffic, or into breaks on the surface which have resulted from frost action or from extraordinary abuse. Such breaks become fewer each year with the proper use of the heavy drags.

We believe that a light application of bitumen is especially important in the fall or just before cold weather sets in, for this renews the life of the surface, fills cracks and breaks, and waterproofs the whole sur-

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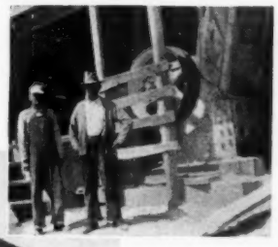

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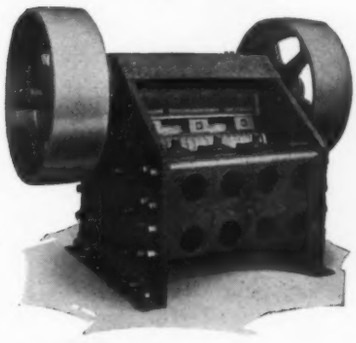

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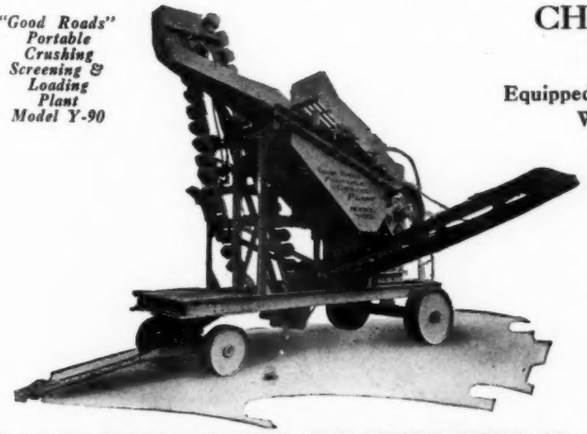

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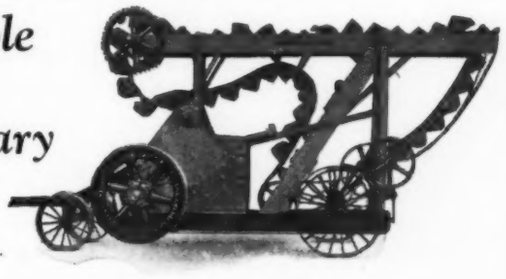

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face so that severe weather conditions and winter abuse do not mutilate the surface as badly as when only one application is made, in the spring or early summer. The fall application is made in the same manner as the spring except that we do not give so much time to the cutting off of corrugations, as we assume that these have been taken care of during the spring and summer, and it is necessary only to seal up the surface and remove the surplus material not absorbed or needed on the surface. The value of this fall oiling cannot be over emphasized.

It is most important, in this maintenance work, that proper bituminous material and sand be used. The bituminous material should be such as will soften the hardened surface, make it more or less pliable and enable the drags to mulch as much of the old material as possible.

For this work Connecticut uses tars of about the same consistency as the ordinary cold tar application, but in some cases uses 45 or 65 per cent asphaltic oil. This seems to give the best result and cuts the old surfaces in just about the right way to enable the drags to shave off the bumps and still not produce a slippery mass that cannot be handled. In some of the older roads too much material was spread on the surface under the delusion that the object was to build up and maintain a top to take the wear of traffic; but we now realize that this was a mistake, and that the purpose should be to apply the oils and tars in as small quantities as will suffice to renew the life of the old surface, to fill the breaks and weather cracks and waterproof the whole surface, then remove the surplus material and let the metal of the travelled portion carry the weight of traffic; rather than build up a plastic mat which cannot help but push and become bumpy when exposed to and softened by the sun. We now remove by dragging as much of this old mat of bituminous material as possible.

We have always used sand as a filler or blotter for the bitumen and have learned that the quality of this sand is as important as that of the oil or tar. Sand which carries a small percentage of loam, clay or slate will cause untold injury to the asphalt or tar, and cause rather than remedy bumpy or wash-board conditions. Sand or filler which carries a small percentage, even a trace, of mineral deposit such as iron pyrites, lead, mica or the like, will cause even greater harm than dirty sand, as such minerals, in slacking, will burn the bitumen and the surface will deteriorate, scale and the whole bituminous application be lost. It may be two or three years before this effect ceases, and even then the mat will show soft and hard spots.

The manner of applying the sand is also of great importance, for unless the filler is very carefully and evenly spread, dry and lean places and cracks or sloppy places will be created. In Connecticut the spreading of this material is done by hand by trained men.

Construction of Heavy Hone

The drags or hones which we use are constructed in our shops, for the most part by the maintenance crews themselves, at an average cost of about $35. They are built of oak timber or other of equal strength, in order that all weaving or springing may be eliminated, especially when the drag is heavily loaded.

They are built either sixteen or eighteen feet long and eight feet wide. The side members are made of 6 x 6 or 4 x 6 timbers. There are four cross members of 4 x 6 oak or ash, set at an angle of forty-five degrees to the side members, all cross members slanting the same way. These cross members are well bolted

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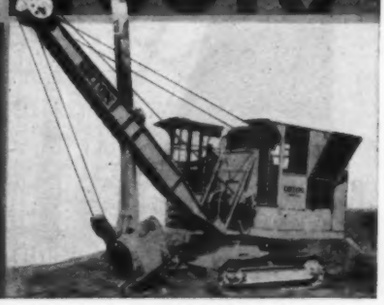

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and braced to overcome any tendency to spring or vibrate. On the face of each cross beam is bolted a steel blade, specially hardened for the work, these blades being set one inch below the cross beam to give a sharp cutting edge. The drag is very heavily stayed and braced over the top with two-inch or three-inch oak planking and the braces holding the cross beams are securely bolted to these planks. This heavy bracing keeps the drag from trembling and causes the blades to cut without springing or slipping. The drags are mounted on iron shoes at each corner, to save the side members when uneven surfaces are encountered and to keep the blades from digging too deep when soft surfaces are gone over or the top is being mulched and depressions filled.

These drags are drawn by 3½-ton trucks and at times are loaded with one or two tons of weight, and when very rough surfaces are encountered even more weight is put on. Many times, when extreme conditions are found, the power of two large trucks may be required to move them over the surface.

Our experience has been that the heavy wood drags are to be preferred to the light-type steel hone, as the wood drag seems to have just enough flexibility to save tearing the surface and still has the proper shearing action on bumps or corrugations. It also leaves a more uniform and smoother surface. In the dragging of fresh or green bitumen, we have found it to be of great advantage to leave the right hand side of the cross beams open; that is, we mount the 6 x 6 side members on top of the cross beams and thus allow all the mulched material to pass out without clogging the drag. This open-end drag also enables us to smooth down the shoulders and brush all the rough material such as stones, rubbish and weeds off the surface and over the edge of the shoulder, and we thus not only keep the shoulders clean and attractive but we build them out with material we formerly were obliged to pick up by hand and cart away.

Philadelphia Water Supply

(*Continued from page 30*)

then passed resolutions requiring actual physical severance between piping systems of the city mains and those carrying water from any other source. However, there has been no systematic investigation of cross connections since 1913 and no indications that either the Bureau of Water or the Bureau of Health has made efforts to discover and eliminate any such connections. The health survey issuing this report, during three days in 1929, visited 18 plants, "and of these, 9 plants were found where piping of a private polluted supply was connected with piping carrying city water in such a way as to present the possiblity of polluted water entering the city water piping system." The inspection was not continued further as it was felt that this showed that cross connections were prevalent and constituted a problem of importance to the health of the city.

The recommendations based upon the above naturally are that the city should do all that it can to hasten the removal of its own sewage pollution from the rivers from which it draws its water supply; that it should place its purification plants in charge of a trained and qualified official, place each of the plants in a first class condition and strengthen the technical personnel. The Bureau of Water should proceed to search syste-

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matically for all existing cross connections and compel the elimination of these hazards from the city supply. In addition to this, a board on water supply should be appointed to investigate other sources of supply and recommend a comprehensive program of future water supply to replace the present practice of dangerous blundering and temporary expediencies.

Street Maintenance and Construction in a Small Municipality

(*Continued from page 32*)

post mould and which are threaded on two long bolts which extend through the entire width of the gang mould and are held by a nut on the end, which is tightened up against the side of the gang mould. These two long bolts are a loose fit inside the ⅜" pipe sections and are readily pulled out after the concrete has set. These posts are set 10 feet on centers and the top and the bottom rails are halved at alternate posts. Some of the posts have had a rubbed finish and some are painted with cement paint. They make a handsome and durable fence. However, we take every opportunity to eliminate guard rail fence by obtaining permission of the owners to use our surplus filling in making a long, easy slope away from the highway.

Clay bricks are not carried in any quantity by any supply house in our city, and since about two months after assuming my duties I have made all our bricks of cement at a cost of about $17 per thousand. A 1 to 6 mix is used for these bricks and they will outtest the bricks which were formerly used. A large stock of these is made up in winter, and this work, together with making the fence posts and other work already referred to, gives winter employment to our men.

Sharp street corners at several prominent intersections have been cut back to a longer radius and this improvement has been so favorably received that several public-spirited citizens have voluntarily offered to give their land for this purpose.

Gravel Roads in Garfield County

(*Continued from page 39*)

immediately after the first rain, additional gravel was bladed onto the road, keeping the ruts filled, and as the traffic was heavy, the gravel was quickly mixed with the sticky mud. After the road had dried, the excess gravel was bladed to the shoulder again, where it remained until the next rain, when the above operation was repeated.

Approximately 750 tons per mile have been mixed with the road in this manner, and we have never had any complaint about loose gravel. It is our opinion that this method of laying this type of gravel road is the most satisfactory we have yet found.

This road has two bad points, viz, after a prolonged dry spell some chuck holes form, and during a prolonged wet spell it becomes slightly slushy. All evidence of these faults is removed, however, by the first blading thereafter, and so far they have developed under exceptional conditions only.

The good points of the road so far offset the bad ones, that we contemplate building more of this type, where the roadside binder is satisfactory, as rapidly as money is available. After the longest rainy spells that we have had since the road has been built, it has never broken through in any place, even when under heavy oil field traffic. It is as easily maintained as a

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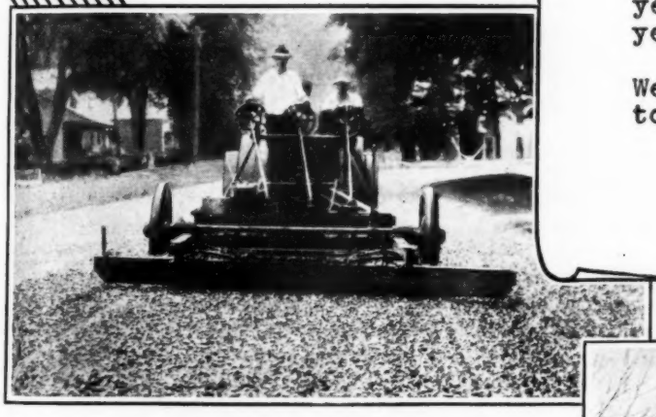
We invite any interested parties to look at our streets.

D. Burlingame

Chairman Street Committee



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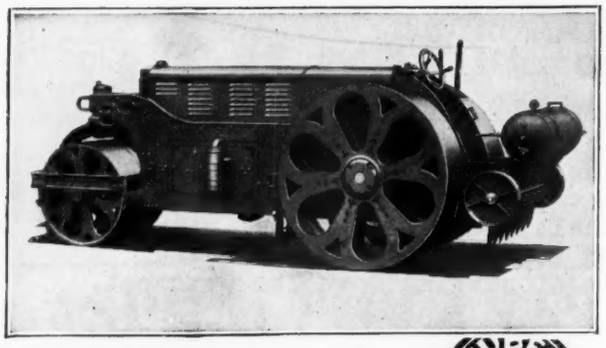

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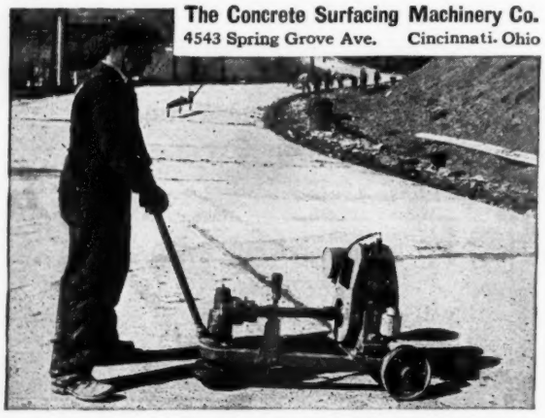

dirt road, but requires much less maintenance than a dirt road. Our experience has been that no gravel road should be maintained except immediately after a rain. This is the cheapest road that we can build in this county. It gives a smooth, water proof surface, except under exceptional conditions, as stated above. It does not skid, even when slushy. It should be very easy to repair, and with the addition of a small amount of gravel each year it shcould last indefinitely.

Sewage Treatment at Schenectady

(*Continued from page 36*)

ing, the beds being submerged once in May, four times in June, three times in July and twice each in August and September. All floodings extended for 24-hour periods, an attempt to shorten the flooding period resulting in a markedly lower killing and a more rapid return of the flies to peak development. Again, it was found necessary to maintain the beds in flooded condition for such long periods in order to permit of auxiliary methods of killing such flies as escaped the submergence and took refuge in sheltered spots. It was found best here to flood during a cool, breezy evening. The maintenance of any tall grass around the filters will prevent success in a fly control campaign since the psychoda seek protection in this vegetation.

Airplane Landings in Mid-Ocean

(*Continued from page 77*)

the seadrome by the largest waves on record and a wind velocity exceeding 160 miles an hour. (Chains can not be used for anchorage, for an anchor chain such as is used by ships would be pulled apart by its own weight before it was long enough to reach the bottom.) At the bottom of the cable is a 40,000-pound cast steel anchor, about 13,000 feet horizontal distance from the seadrome in 12,600 feet of water.

Rolled Vitrified Clay Slabs for Pavements

Prof. Joseph B. Shaw, head of the Dept. of Ceramics, Pennsylvania State College, and Myril C. Shaw have developed a new method of treating vitrified clay for producing a paving material or other purposes; the general principle being a welding of two or more layers of clay while undergoing vitrification, by rolling under great pressure, as in the manufacture of steel plates.

Slabs of clay only one or two inches thick can be dehydrated and oxidized by heat in a small fraction of the time required for masses of clay of several times this thickness; and these relatively thin slabs, when at a stage of relative fluidity attained during vitrification, can be compressed by rolling into a homogeneous block. If desired, steel reinforcement can be inserted between sheets during the rolling. Thus large slabs of vitrified clay, of any desired size or thickness, reinforced or not, can be produced, it is reported, at relatively low cost.

Snow Removal on Minnesota's Roads

The Minnesota Highway Department last winter spent $210,000 on removing snow from its entire trunk highway system, an average of $30 a mile. During the winter of 1928-'29 it spent $499,829. These figures include outlays for snow fence and snow plows and a prorated allowance for trucks and tractors. The decrease last winter was due partly to the use of heavy, high-speed truck-plow units operated by the regular sectionmen, partly to less snow fall.

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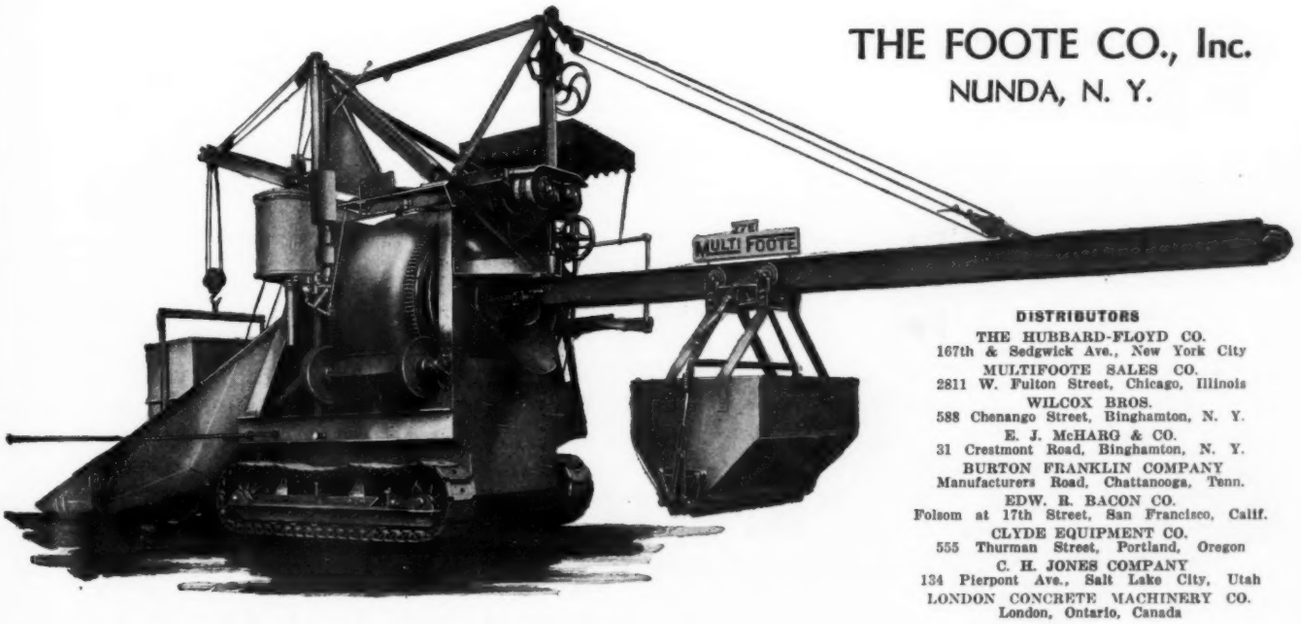

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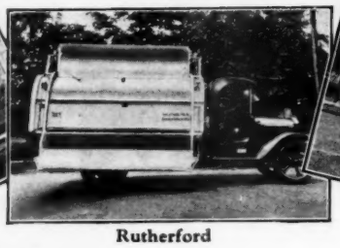
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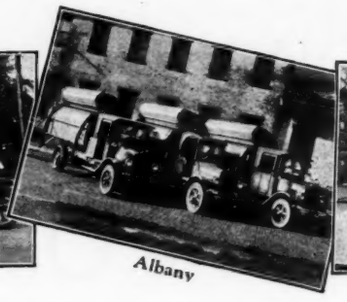
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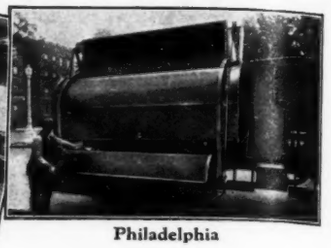
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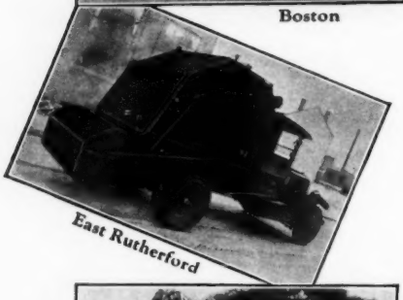
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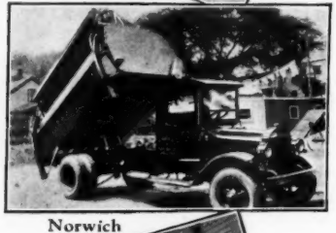
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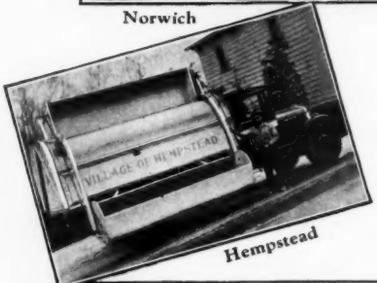
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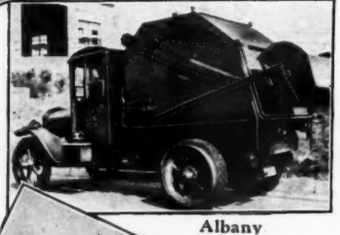
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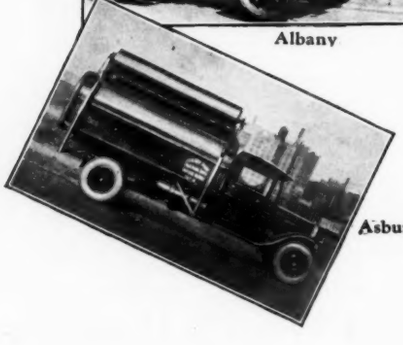
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October 27-31—AMERICAN PUBLIC HEALTH ASSOCIATION. Annual meeting at Fort Worth, Texas. Executive Secretary, Homer N. Calver, 370 Seventh Avenue, New York.

American Water Works Association

All available exhibit space has been taken for the annual convention of the American Water Works Association, which will be held at St. Louis, Mo., June 2 to 6. The following will exhibit:

Pittsburgh Equitable Meter Company, Water Works Engineering, The American City Magazine, Rensselaer Valve Company, National Water Main Cleaning Co., R. D. Wood & Company, Lock Joint Pipe Company, Gamon Meter Company, The Leadite Company, Bingham & Taylor Corp., Ross Valve Mfg. Co., Inc., Neptune Meter Company, The American Rolling Mill Co., Paradon Mfg. Company, Wailes-Dove-Hermiston Corp., Builders Iron Foundry, The A. P. Smith Mfg. Co., H. W. Clark Company, Buffalo Meter Company, National Tube Company, The Central Foundry Co., Public Works (Journal), Chicago Bridge & Iron Works, The American Brass Company, Wallace & Tiernan Co., Inc., Michigan Valve & Foundry Co., Columbian Iron Works, Waterous Company, McWane Cast Iron Pipe Co., Hays Manufacturing Company, Vogt Bros. Mfg. Company, Gillette Publishing Company, United States Pipe & Foundry Co., Eddy Valve Company, Hydraulic Development Company, Iowa Valve Company, Worthington Pump & Machinery Corp., East Jersey Pipe Company, De Laval Steam Turbine Company, The Pitometer Company, Pittsburgh-Des Moines Steel Company, International Filter Company, Mueller Co, Inc, Fairbanks, Morse & Company, Engineering News-Record, National Meter Company, Ludlow Valve Mfg. Co., Ford Meter Box Company, Badger Meter Mfg. Co., Hersey Manufacturing Co., R. W. Sparling, W. & L. E. Gurley, American Cast Iron Pipe Co., The Atlas Mineral Products Co. of Penna., The Kennedy Valve Mfg. Company, Joseph G. Pollard Co., Inc., Edson Manufacturing Corp., Johns-Manville Corp., Lead Lined Iron Pipe Co., The Dorr Company, National Cast Iron Pipe Co., Omega Machine Company, Automatic Cone Valve Co., Barber-Greene Co., Layne & Bowler Co.

Oklahoma Water Works Short Course

The Sixth Oklahoma Water Works Short Course will be held at Stillwater, Okla., May 11 to 15. Headquarters of the school will be at Room 105, Engineering Building, Oklahoma A. and M. College. The program calls for registration Tuesday morning, after which instruction will begin. Sewage sessions will be held Thursday, while a swimming pool conference will take place Friday.

Virginia Water and Sewage Works Association

The second annual convention of the Virginia Water and Sewage Works Association will be held at the Nansemond Hotel, Ocean View, Norfolk, Virginia, June 19th and 20th. The program contemplates a number of interesting papers and discussions with reference to plant operation in treating the variety of raw water supplies obtained in the state; also papers and discussions dealing with impounding reservoirs and maintenance of watershed areas. The program also includes discussion of the application of advantageous methods of sewage treatment.

American Road Builders' Association

The regular annual meeting of the Association will be held Thursday afternoon, May 15th, at three o'clock, at the offices of the Association, 914 National Press building.

The officers and directors elected at the recent convention in Atlantic City will be installed at this meeting, and the reports of the President, the Treasurer, the Engineer-Director and the Board of Directors of the Association and of the Presidents of the various Divisions will be received and such other business transacted as may seem necessary.

The annual President's dinner of the Association will be held Thursday evening, at seven o'clock, at the Willard Hotel. It is necessary that all members planning to attend the dinner notify the Association not later than May 10, so that the necessary details may be arranged.

The regular annual meeting of the City Officials' Division will be held Friday morning, May 16, at eleven o'clock, at the offices of the Association. At this meeting will be installed the officers and directors of the Division elected at the recent meeting in Atlantic City, and the reports of the Board of Directors and of the officers whose terms expire at this meeting will also be received and any other necessary business transacted.

The regular annual meeting of the County Highway Officials' Division will be held Friday morning, May 16, at eleven o'clock, at the offices of the Association. The officers and directors of this Division elected at the recent meeting in Atlantic City will be installed, and the reports of the Board of Directors and of the officers whose terms expire at this meeting will be received and such other business as may be deemed necessary will be transacted.

Sixth International Road Congress

Delegates from fifty-six countries will have an opportunity to study the best products of American highway machinery manufacturers at an international road exhibition to be held in Washington Oct. 7-10, 1930. The exhibition will be held by the American Road Builders' Association simultaneously with the sixth international road congress.

The congress program will give much space to the progressive ideas and

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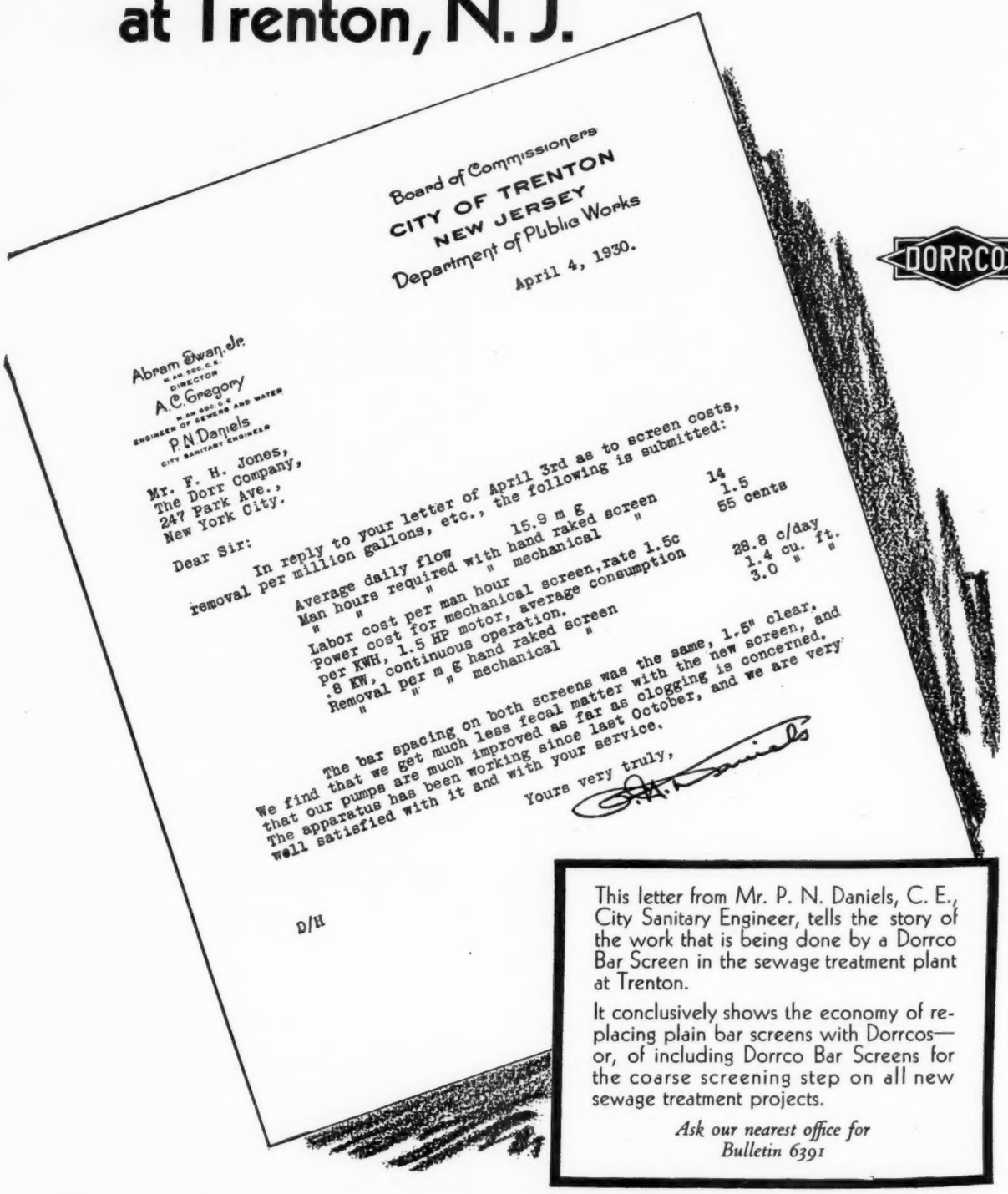
THE PLAZA
551 Cass at E. State
On U. S. Highway 141
MILWAUKEE

What a Dorrco Bar Screen is doing at Trenton, N. J.



Board of Commissioners
CITY OF TRENTON
NEW JERSEY
Department of Public Works

April 4, 1930.

Abram Swan, Jr.
M. AM. SOC. C. E.
DIRECTOR
A. C. Gregory
M. AM. SOC. C. E.
ENGINEER OF SEWERS AND WATER
P. N. Daniels
CITY SANITARY ENGINEER

Mr. F. H. Jones,
The Dorr Company,
247 Park Ave.,
New York City.

Dear Sir:

In reply to your letter of April 3rd as to screen costs, removal per million gallons, etc., the following is submitted:

Average daily flow	15.9 m g	14
Man hours required with hand raked screen		1.5
" " " " mechanical		55 cents
Labor cost per man hour		
Power cost for mechanical screen, rate 1.5c per KWH, 1.5 HP motor, average consumption		28.8 c/day
.8 KW, continuous operation,		1.4 cu. ft.
Removal per m g hand raked screen		3.0 " "
" " " mechanical "		

The bar spacing on both screens was the same, 1.5" clear. We find that we get much less fecal matter with the new screen, and that our pumps are much improved as far as clogging is concerned. The apparatus has been working since last October, and we are very well satisfied with it and with your service.

Yours very truly,

P. N. Daniels

D/H

DORRCO

This letter from Mr. P. N. Daniels, C. E., City Sanitary Engineer, tells the story of the work that is being done by a Dorrco Bar Screen in the sewage treatment plant at Trenton.

It conclusively shows the economy of replacing plain bar screens with Dorrcos—or, of including Dorrco Bar Screens for the coarse screening step on all new sewage treatment projects.

Ask our nearest office for Bulletin 6391

DENVER, COLO. 1009 17th Street
CHICAGO, ILL. 333 North Michigan Avenue
LOS ANGELES, CAL. 108 West 6th Street
WILKES BARRE, PA. Miners Bank Building
ATLANTA, GA. 1503 Candler Building
TORONTO, ONT. 330 Bay St.

THE DORR COMPANY
ENGINEERS
247 PARK AVENUE NEW YORK CITY

INVESTIGATION TESTS DESIGN EQUIPMENT

MELBOURNE, AUSTRALIA
Crossle & Duff Pty., Ltd., 360 Collins Street

TOKYO, JAPAN
Andrews & George Co., Inc., Central P. O. Box F-23

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The Dorr Company, Ltd.
Abford House, Wilon Rd., S. W. 1

BERLIN
Dorr Gesellschaft m. b. H.
Kielganstr, 1 W. 62

PARIS
Societe Dorr et Cie
26 Rue de la Pepiniere

JOHANNESBURG, S. A.
E. L. Bateman
Locarno House.

For latest catalogs — consult the *classified* INDUSTRIAL LITERATURE section, pages 133 to 140.

methods of American engineers. Oddly enough, this nation, which leads the world in improved roads, is entertaining the international road congress this year for the first time.

The exposition will be held in Washington Auditorium. Outdoor space nearby will also be used for exhibits and a demonstration of road building machines under working conditions will be staged.

In addition to an estimated 400 American manufacturers who will have equipment in the exhibit, manufacturers from all other countries have been urged to send exhibits, so that both the exposition and the congress may be truly representative.

Exhibits from outside the United States will be shipped and returned in bond, thus avoiding duty fees. Invitations to participate are being transmitted to all countries through the foreign service of State Department and the Department of Commerce. The bureau of public roads will have an educational exhibit, representing the United States government.

American Water Works Association

Florida Section

The fourth annual meeting of the Florida Section, American Water Works Association was held in Gainesville, Florida, on April 10th and 11th. It was preceded by the first Short Course in Water and Sewage Treatment offered by the General Extension Division of the University of Florida, in conjunction with the Florida Section, American Water Works Association, and the Florida State Board of Health, on April 8th and 9th. Enrollment for the Short Course exceeded the expectations of those in charge, sixty-nine having registered during the two days in which it was given. Conforming with the request of the Association the short course will be made an annual affair, and the time will be extended to four or five days, thus permitting a more thorough treatment of the subjects discussed.

The registration for the Fourth Annual Meeting was the largest in the history of the section, some one hundred and twenty-five being in attendance. Durng the two day session nineteen papers were presented and discussed. Among them were: Treatment of Boiler Waters, Prof. Edward Bartow, University of Iowa, Iowa City, Iowa; Hardness in Water Supplies in the United States, W. D. Collins, Chief Chemist, Division of Quality of Water, U. S. Geological Survey, Washington, D. C.; Federal and State Co-operation on Investigation of Water Resources, N. C. Grover, Chief Hydraulic Engineer, U. S. Geological Survey, Washington, D. C.; Certifying Water Supplies for Interstate Carrier Use, R. E. Tarbett, Sanitary Engineer, U. S. Public Health Service, Washington, D. C.; Chlorine —Its Use in Water Treatment, Linn H. Enslow, Engineer, Chlorine Institute, New York City; A Practical Program for Elimination and Control of Cross Connections, C. W. Mowry, Boston, Massachusetts, Manager, Inspection Division, Associated Factory Mutual Fire Insurance Company.

Speakers at the various luncheons and banquets included: Beekman C. Little, Secretary, A. W. W. A., Rochester, New York; Malcolm Pirnie, Consulting Engineer, New York; Arthur E. Gorman, The Wallace-Tiernan Company, Newark, New Jersey; President John J. Tigert, University of Florida, Gainesville, Fla.; Herman Gunter, State Geologist, Tallahassee, Florida; Dr. Henry Hanson, State Health Officer, Jacksonville, Florida; E. G. Eggert, Texas State Board of Health, Austin, Texas; Dr. Paul Eaton, Chief of Diagnostic Laboratory, Jacksonville, Florida; G. H. Hazlehurst, Alabama State Board of Health, Montgomery, Alabama; C. S. Howard, Division of Quality of Water, U. S. Geological Survey, Washington, D. C.; W. P. King, District Engineer, U. S. Geological Survey, Chattanooga, Tennessee; Arthur P. Miller, Associate Sanitary Engineer, U. S. Public Health Service, Washington, D. C., and oothers.

West Palm Beach, Florida, was selected as the meeting place for 1931. Officers elected were as follows: A. P. Black, Professor of Chemistry, University of Florida, Gainesville, Florida, Chairman; F. W. Lane, St. Petersburg, Florida, Vice-Chairman; E. L. Filby, State Board of Health, Jacksonville, Florida, Secretary-Treasurer, (reelected). Director for 1932, J. R. Hoy, Jacksonville, Florida. Directors for 1933, J. R. Tanner, West Palm Beach, Florida, and T. W. Grant, Tampa, Florida. Representative to the National Council, A. W. W. A., A. P. Michaels, Orlando, Florida.

Retiring officers for the year are: Ralph W. Reynolds, West Palm Beach, Florida, Chairman; Charles H. Eastwood, Jacksonville, Florida, Vice-Chairman; E. L. Filby, Jacksonville, Florida, Secretary-Treasurer, (reelected).

Personals

J. F. Coleman, formerly maintenance engineer of the State Highway Board of Georgia, with offices at Waycross, has been appointed chief engineer of the Southern Region, National Paving Brick Manufacturers Association, with headquarters in Decatur, Ga.

Nicholas S. Hill, Jr., consulting engineer of 112 East 19th St., New York, has admitted into partnership Horace H. Chase. Mr. Chase has been associated with the firm for a number of years.

Julius Kahn, president of the Truscon Steel Company, announces the appointment of Oscar W. Loew as a vice-president of the Truscon Steel Company. Mr. Loew has been director of advertising and sales promotion of Truscon for the past six years.

H. Eltinge Breed, consulting engineer, 507 Fifth Avenue, New York, announces the closing of his office after his departure on April first to do engineering work in Russia. Until his return in the autumn his address will be School of Enginering, New York University, University Heights, New York, where his work during his absence will be in charge of his associate, professor Elmer G. Hooper.

W.-K.-M. Company, Inc., manufacturers of oil field, pipe-line, and industrial equipment, announce the appointment of Alexander J. Duaei as manager of sales, western territory. Offices have been established by the company at 205 West Wacker Drive, Chicago. Prior to associating himself with W.-K.-M. Company, Mr. Duaei was for eleven years connected with the Johns-Manville Company, seven years of which he was manager of the public utilities division of that organization. Mr. Duaei was born in Amsterdam, Holland, and was educated in New York and European universities.

Trade Publications

Centrifugal Pump Priming.—Bulletins describing the most effective means for priming centrifugal pumps manually are now available. The following subjects are fully covered in these publications: The Theory of Priming; Submerged Pumps; The Use of Foot Valves; Air, Steam, and Water Ejectors; Hand Operated Priming Pumps; Motor Driven Priming Pumps; Arrangement of Intake Piping. The complete set of bulletins, bound in looseleaf form, may be had by writing to Barrett, Haentjens & Company, Hazleton, Pa

Chain Information Book.—This book gives in a most concise way facts and figures concerning all types of welded chain. There are tables of sizes, weights, loads and directions for taking measurements. It also tells how to order chain in accordance with the A. S. T. M. and A. R. A. Specifications with excerpts from these specifications, and contains the rules and cautions issued by the Chain Institute.

It may be secured from Public Works or by addressing the American Chain Company, Inc., Bridgeport, Conn.

Motion Pictures and Illustrated Lectures.—The many illustrated lectures listed in this booklet were prepared by the General Electric Company for the use of schools, colleges, and engineering societies. All texts and slides are furnished without charge. The texts and filmslides may be retained by the user, but all glass slides must be returned with transportation prepaid. New lectures are in course of preparation, and requests for subjects other than those listed will be considered. Address all requests for lectures to the Educational Specialist, care of any G-E sales office or write directly to Lecture Service, Publicity Department, General Electric Company, Schenectady, N. Y.

EACH CALL MUST BE HANDLED SEPARATELY, EACH FITTED TO THE NEEDS OF THE INDIVIDUAL WHO MAKES IT

65 million calls a day . . . each one made to order

An Advertisement of the American Telephone and Telegraph Company

WHEN you pick up your telephone, you may use $10,000 worth of equipment to talk to your neighbor three blocks away, or $10,000,000 worth of equipment to talk 3000 miles across the continent. Each call must be handled separately, each made to order. To render this service in a way that fits the needs of the American people, the operation of the System is conducted by 24 different companies, each adapted to the area it serves.

These Associated Companies have the benefit of study and analysis by the staff of the American Telephone and Telegraph Company, leading to progressive improvements in service.

Each of the Bell Companies takes advantage of the research findings of the Bell Laboratories, commanding scientific talent unsurpassed in any industry.

The quality and precision manufacture of the telephone equipment and apparatus used by the entire System are assured by the specialized production methods of the Western Electric Company, which manufactures for the Bell System.

Today the Bell System is building ahead of the requirements of the public—to the end that the people of this nation may have the greater telephone facilities which they will need tomorrow.

New Catalogs

Page Buckets.—Bulletin 400A describes buckets having a struck measure capacity from ⅜ to 2 cubic yards, trench buckets and drag slips; Bulletin 500A covers buckets from 2½ to 10 cubic yards struck measure capacity.

Curing Concrete by the Hunt Process.—A 12-page booklet put out by McEverlast, Inc. It contains information of value to anyone working with concrete. It describes the material used in the Hunt Process, and tells the results obtained.

Caterpillars on Road Work.—A beautifully illustrated 16-page booklet showing Caterpillar tractors on a variety of road-building jobs.

Contractors' Equipment.—Littleford Bros. Co., Cincinnati, Ohio, has just published catalog F, a 32-page illustrated catalog describing asphalt kettles, coal, oil and wood burning; heaters; grout mixers; tool boxes; line markers; and other equipment.

Road and Street Maintenance Equipment.—Littleford Bros., Cincinnati, O., have published a pocket size book showing their complete line of maintenance equipment.

Contractors' Equipment.—Littleford Bros., Cincinnati, O., have published a 32-page book describing all of their contractors equipment, including tar kettles, tool boxes, lead furnaces, concrete heaters, etc.

Tractor Equipment.—The W-K-M Co., Inc., Houston, Texas, has published a booklet illustrating, describing and giving full specifications of W-K-M industrial equipment. Among the equipment described is the side-boom units for caterpillar tractors, the W-K-M Day jaw crusher, the Simplex filler for refueling gas tanks, the W-K-M boom, the bulldozer and side-winch for backfilling, the deep well winch, and the truck winch. These are of interest to construction men. The booklet can be obtained from PUBLIC WORKS by using the form on page 133, or by addressing the W-K-M Co., at Houston, Tex.

United Crawler Tractor.—A new eight-page circular, attractively printed in the United orange and black, describes the power, performance, speed, endurance and dependability of the United crawler tractor for road building, general construction jobs, snow removal, hauling, etc. The booklet is illustrated with interesting pictures and gives measurements and specifications of the United. It may be obtained from the Trackson Co., Milwaukee, Wis., manufacturers of the crawler tracks.

Electric Equipment for Handling Heavy Materials.—The General Electric Co. has brought out an illustrated 24-page booklet on this subject.

Power Shovels.—"The Right Arm of Progress" is the title of an interesting booklet put out by the Bucyrus-Erie Co., So. Milwaukee, Wisc. It reviews briefly the development and uses of power shovels.

Heavy Duty Shovel.—Bay City Shovels, Inc., Bay City, Mich., has published catalog R-3, sixteen pages and cover, describing the Bay City Model R, a ¾-yard heavy-duty, full-revolving convertible power shovel, which is manufactured to operate shovel, clamshell, trench hoe, skimmer, dragline or crane booms.

Highway Equipment.—A new folder issued by the General Wheelbarrow Co., Cleveland, O., describes a line of grader blades, maintenance equipment, plows, carts, barrows, etc.

Engineering and Construction Equipment

New Machinery, Apparatus, Materials and Methods and Recent Installations.

Hand Work Eliminated by Tamper and Backfiller

The Cleveland Trencher Company of Cleveland, Ohio, who for many years have been manufacturing trench digging equipment, have announced a new machine which combines the related operations of tamping and back-filling. This machine is of special interest because by its use the necessity of tamping and backfilling with hand-labor is eliminated.

The Cleveland Tamper-Backfiller is but 58 inches in extreme width, thus permitting it to be used in narrow and confined areas. It is mounted on full crawler tracks for ease of handling and to enable it to travel over rough ground, across excavations, etc.

The tamping mechanism, which will work either at the center or side of the machine, consists of a 150-pound steel tamping head which can be dropped 45 times per minute from a height of 26 inches. Gear shift speed changes provide instant means of determining the number of blows struck per given distance according to soil requirements.

It is interesting to note that with this mechanical tamping materials such as wet clay, which is exceedingly difficult to tamp by hand, are very easily handled with the Cleveland Tamper. This also eliminates any necessity of hauling away the wet clay, and the expense of backfilling with some other material like sand or gravel. Moreover, the Cleveland Tamper will replace the earth so tightly that less remains to be hauled away.

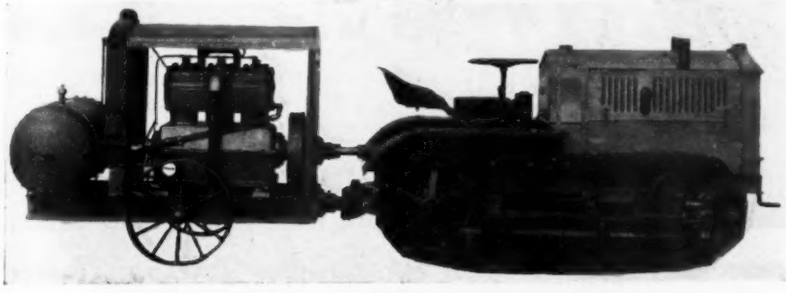
The usual method of tamping with the machine is to straddle the trench and tamp in the center, but where obstacles do not permit this type of work the mechanism of the Cleveland Tamper may be easily and quickly swung so that the machine may run parallel with the trench and tamp at full efficiency.

Backfilling and tamping speeds of 3½, 7 and 11½ feet per minute are available, and the unit has a road speed of five miles per hour.

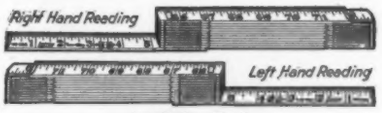
The backfiller, of a conventional type, operates with a telescopic boom with a length which can be varied from 14 feet 2 inches (telescoped) to 20 feet 2 inches (fully extended). The entire unit is self-contained and is powered by a four-cylinder Hercules model OX gasoline motor.

Schramm Compressor Attached to Model "20" Cletrac

Schramm, Inc., West Chester, Pa., has brought out a new self-propelled compressor unit that can be driven under its own power, over paved streets, or the roughest surfaces. The compressor is shipped ready to attach to the Cletrac, it being necessary only to install the power take-off shaft on the tractor together with the double universal joint and long spline shaft coupling, and bolt the universal draw bar coupling to the cross piece of the draw bar. This can be done by any unskilled mechanic and results in a flexible hook-up that lends itself to any traffic.



Schramm Compressor Attached to Cletrac "20"



Lufkin Rule

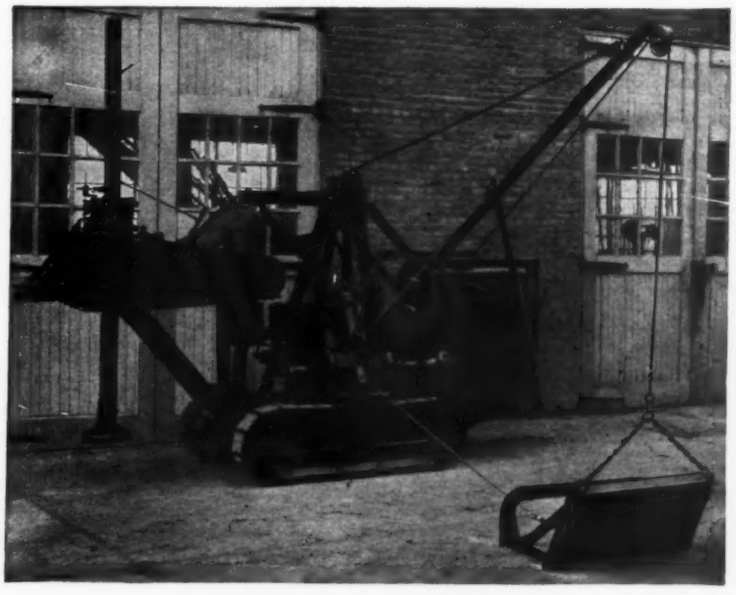
One of the big advantages of a combination of this type is the fact that the compressor can be uncoupled easily and the tractor used for many other purposes. On hauling especially, the full power of the tractor is available, a feature not found in combinations where the compressor is mounted right on the tractor. Another point is the fact that the power take-off of the tractor is also available for operating other power units.

A combination of this type is especially adapted to the needs of road builders, general contractors, state and county highway departments, municipalities, gas and water works, bridge builders, iron and steel erectors, quarries and others who operate pneumatic tools.

The tractor can be started separately from the compressor, by means of a throw-out clutch on the power take-off of the tractor. This makes starting easier and quicker and keeps the compressor idle when driving from one job to another.

A New Folding Rule

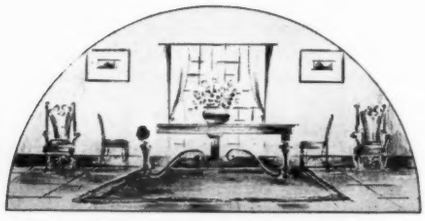
A spring joint folding wood rule with several new and valuable features has just been put on the market by the Lufkin Rule Company, factory and main office, Saginaw, Mich., Eastern sales branch, 106 Lafayette street, New York



The Cleveland Tamper and Backfiller

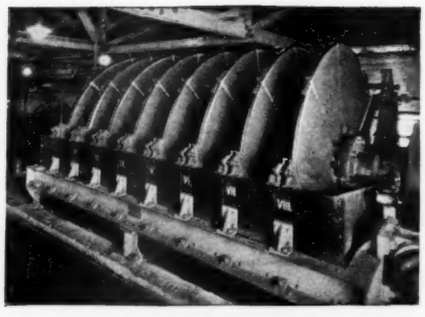
SEWAGE TREATMENT

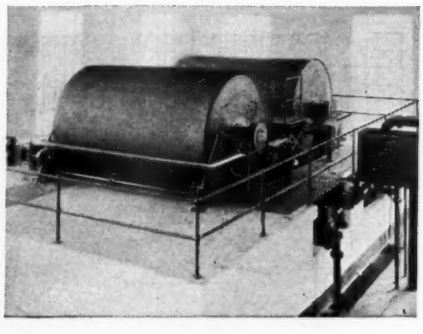
"Suitable for the Dining Room"



THIS is no exaggeration. As a matter of fact, when the Charlotte, North Carolina, officials opened for public inspection their activated sewage filter station, a buffet lunch was served to 250 guests right alongside the open Oliver United Sludge Filters.

What other sewage treatment is so free from offensiveness? What other treatment could so eliminate odors and flies as to permit serving a meal within ten feet of the solids discharged openly from the filter?





In addition to this cleanliness, economy is an outstanding feature of activated sludge filtration—the economy is due to the fact that the solid matter, after filtration, makes excellent fertilizer. In several of the Oliver United stations it is being sold as such.

Oliver United engineers, who are thoroughly conversant with the activated method of sewage treatment, will be glad to consult with public officials and consulting engineers regarding this sewage treatment for their communities.

OLIVER UNITED FILTERS INC.

JOHANNESBURG E. L. Bateman
TOKYO American Trading Co., Inc.
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HONOLULU W. A. Ramsay Co.
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City. It is known as the "Two Way—Red End" rule and lays claim to a number of decided advantages for carpenters and other mechanics, as well as all those who do common measuring.

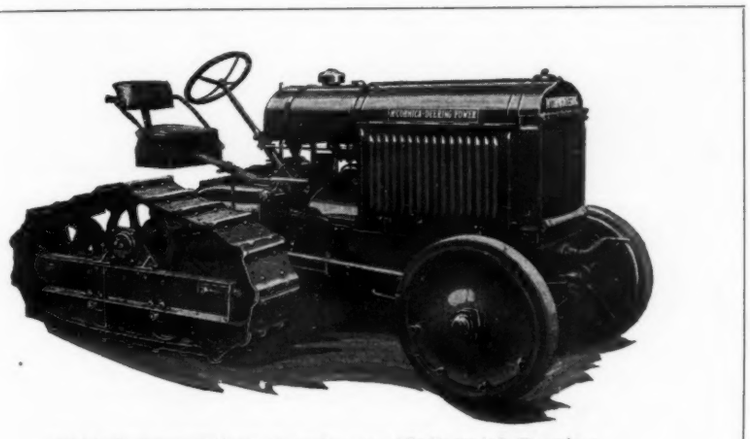
On one side of the "Two Way" rule figures run from left to right, i.e., right hand; on the other side they run from right to left, known as left hand. These two features have never before been incorporated in one rule. Right hand is the natural direction for much common measuring; left hand is most convenient when rule is held in left hand with pencil or saw in the right. With the "Two Way" rule the figures are right-side-up to the user in many measuring operations where heretofore figures appeared up-side-down. Thus convenience is served and chances of error eliminated. For example, to find the balance of space completing any measurement, (when measuring distances longer than the rule), simply extend and turn over the rule and all figures still appear right-side-up. It is handy also in measuring left and right out of any corner. Furthermore, the "Two Way," when measuring a board, a building, or across a room, is equally convenient starting to measure from the left or the right hand end or wall. This new rule also has on both sides inside or flat markings, thus the portion being used lies flat on the work. Another feature, the 16ths are on the upper instead of lower edge, so they naturally fall closest to the edge of the work being measured or marked. This new rule has many other most handy applications.

It is made in white enamel finish, 5/8 inch wide with 6-inch sections, and in 4, 5 and 6-foot lengths. The "Two Way" is an addition to the Lufkin "Red End" rules, which have proven very popular with mechanics and others. This means that "Two Way" rules have rust-proof metal spring joints and trimmings, strike plates preventing wear of markings in opening and closing, superior white enamel finish, and distinctive bright red ends. They are a rule of the highest grade throughout. They are being marketed through hardware and tool stores generally throughout the United States.

New Rear-Type Crawlers Developed by Warco

The W. A. Riddell Company of Bucyrus, Ohio, have just announced improvements and refinements for their model "TG" rear-type crawler. This crawler is intended for use upon McCormick-Deering 10-20 Industrial tractors. These new crawlers are full ball and roller bearing equipped and are mounted upon the same tractor rear axle as rubber tired wheels, so that the change from one type of mounting to another can be made in a short time.

Warco "TG" crawlers are particularly valuable when used in power graders, bulldozers or in fact any service where it is essential that the tractor be maintained on an even keel or where a cutting blade is required to cut to close limits. "TG" rear-type crawlers do this because they are free to oscillate, one independent of the other, and do not raise the front end of the tractor when running over obstacles, as is the case when using full type crawlers. Tests made with these crawlers mounted upon a tractor equipped with bulldozer showed conclusively that it is possible to run over obstructions with one crawler at a time or with both crawlers simultaneously without materially affecting the elevation of the bulldozer blade.



Riddell Rear Wheel Crawler on McCormick-Deering

In power grader service rear-type crawlers have long been accepted as being superior to any other type of mounting, because their freedom to oscillate relieves the grader frame of the more severe stresses and strains, thereby prolonging the life of the grader and, incidentally, producing better work.

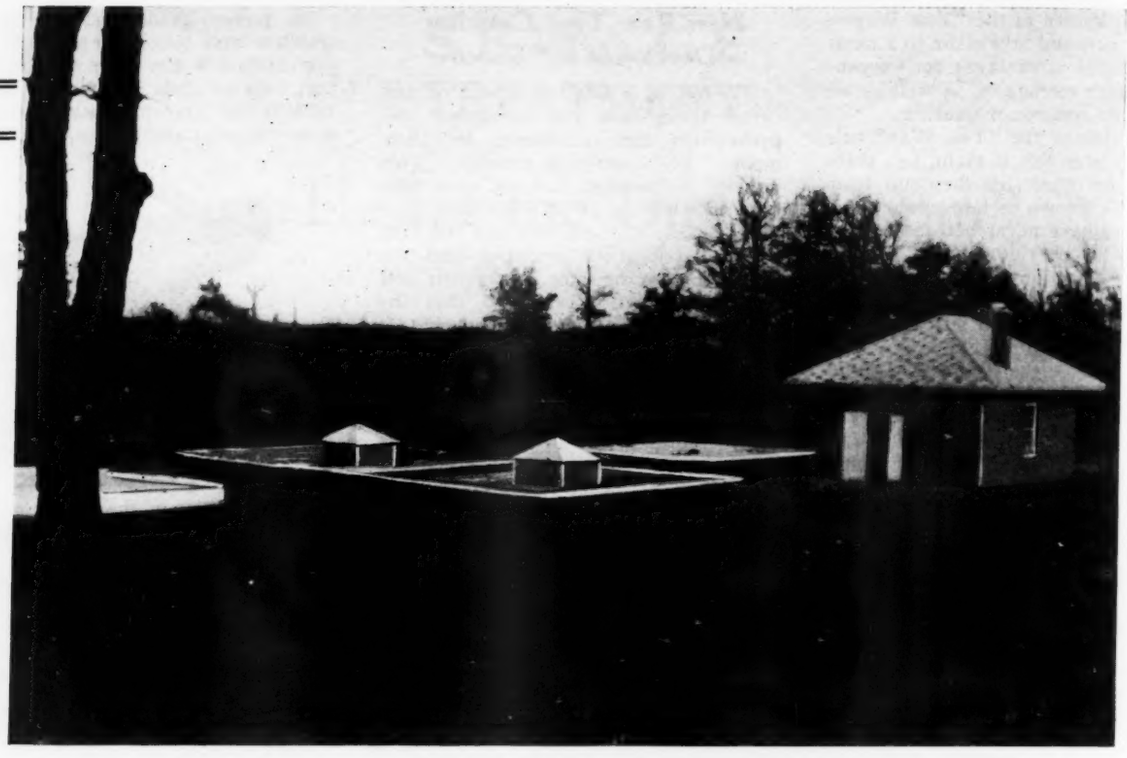
Kern Tacheometer

An Accurate Kern Leveling Tacheometer

This Kern Leveling Tacheometer, which is handled by Kern Co., N. Y., has as a foundation the Kern dumpy level I. The telescope, of the internal focusing type, is moisture-proof and dustproof, and is cast of one piece with the vial level housing. It is analytic with a multiplication constant of 100.0, and a tacheometrical addition constant of 0. A collapsible mirror attached to the vial level enables the operator to check up the position of the bubble from the eyepiece end of the telescope. The telescope and level block are mounted so that they may be tilted by means of a micrometer screw which reads to an accuracy of 1/100 of 1 per cent of angle. The telescope may be turned around the vertical axis of the instrument and the angles read by means of a vernier and magnifier to 1 minute accuracy. The telescope may be tilted 10 per cent up or down, which makes the instrument usable as a tacheometer replacing a theodolite in terrain with gradients within 10% up or down.

A remarkable feature of the instrument is the construction of the gradienter screw which can be easily adjusted and on which the direct reading of 0.1

The Riddell TG Crawler Equipped With Rear Wheel Crawlers at Work With Riddell Wheeled Scoops on Grading



Sewage Purification Plant for the Village of North St. Paul, Minnesota. Two Simplex Aerator Units. Designed by Druar & Milinowski, Consulting Engineers, of St. Paul, Minnesota.

Municipal Officials

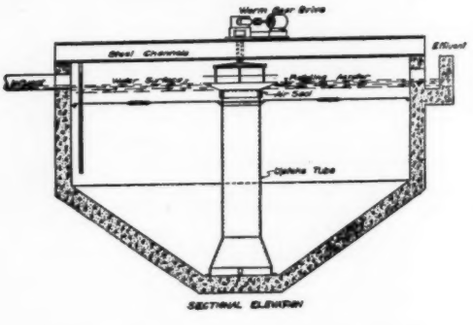
IS YOUR community faced with a problem of sewage disposal? If so, you will be interested in a Simplex type plant, which can be constructed at a lower initial investment than the filter type plant. An accurate cost comparison will demonstrate this fact.

The Simplex type plant will provide the highest degree of purification possible without the usual odors and gnat nuisances.

Ask your engineer for an estimate of cost for a Simplex installation.

Build a **modern** Sewage Purification Plant.

Single Simplex AERATOR unit in tank



The revolving aerator receives its sewage through the uptake tube from bottom of tank and is equipped with vanes that throw an upper and lower film of sewage over the surface of the tank. Oxygen absorbed by the films, the surface agitation and complete circulation of sewage will give any degree of nitrification desired, determined by the detention period in the tank.

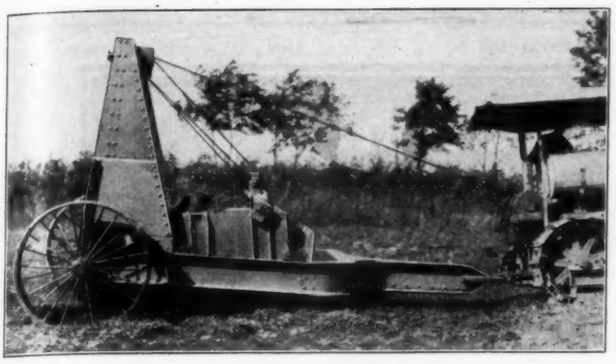
Sole Manufacturers in the United States and Canada

SIMPLEX *SURFACE* AERATOR

SIMPLEX EJECTOR AND AERATOR CORPORATION

2528 W. Madison Street, Chicago

For latest catalogs — consult the *classified* INDUSTRIAL LITERATURE section, pages 133 to 140.



The Shaw 2-Wheel Scraper Is Designed for Easy Handling by One Man. It is made in Three Sizes

per cent may be taken; i.e., ⅛ inch in a distance of 100 ft. One-tenth of this fraction can still be estimated, which makes this little instrument of outstanding accuracy. The telescope carries the standard Kern stadia for stadia measurements, but by means of the vertical gradienter screw the reduced distances can be obtained direct without calculation.

Every sensitive part of the instrument is fully enclosed so that it may be used in the dustiest and dampest places. Owing to its small size, the instrument stands very firm on its tripod in high wind despite its light weight of only 1.8 kilos.

The outside dimensions of the instrument case are 22 x 17 x 11 cm.

A tripod with stiff legs or with telescoping legs may be selected with the instrument.

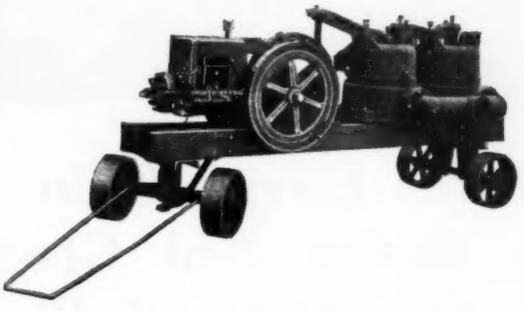
For all street and waterworks construction the Kern Leveling Tacheometer is claimed to be the modern universal instrument.

New International A-5, 3-Ton Speed Truck

The new 3-ton speed truck, Model A-5, recently announced by International Harvester is designed and built to meet a wide range of hauling requirements. This model is built in four wheelbases—156-inch for dump and semi-trailer service, 170, 190, and 210-inch for general hauling of all kinds. The longer wheelbases provide for maximum body lengths (back of cab) as follows: 170, 190, and 210-inch wheelbases; 13 feet, 15 feet, and 17 feet 6 inches respectively. Two and one-half yard dump bodies of 9 feet or 9 feet 6 inches in length may be mounted on the 156-inch wheelbase chassis.

Among the features of this truck are the 6-cylinder engine with its 7-bearing crankshaft, 7-bearing camshaft, and removable cylinders; the single-plate clutch with built-in vibration damper; a new and exclusive transmission with five speeds forward and one reverse; new spiral bevel gear drive axle; the latest type mechanical four-wheel brakes; heavy pressed-steel channel tapered frames, and others of equal importance.

Transmission reductions are as follows: first, 7.35 to 1; second, 5 to 1; third, 3.13 to 1; fourth, 1.75 to 1; fifth, direct, or 1 to 1; and reverse, 9.04 to 1. This feature permits high speed for cross country hauling, while the four low-speed reductions provide enormously increased pulling ability for hill climbing and negotiating sand, mud, or soft roads. Axle reductions of 7.16 to 1 and 6.43 to 1 are provided.



The Nelson Jumbo Pump is Especially Designed for Heavy Trench Work

Service brakes are of the mechanical, internal expanding, self-energizing, 2-shoe type, operating on all four wheels. Cast, spoke-type wheels, with integral hubs, equipped with pneumatic tires, are used on the Model A-5. Standard tires are 34 x 7 front and 34 x 7 duals rear. The chassis equipment includes streamline cowl, dash with instrument panel, front fenders, and short running boards, chromium plated radiator shell, underslung tire carrier, spare rim, and bumper.

International 3-Ton Speed Truck

Shaw "True-Cut" 2-Wheel Scraper

The Shaw Excavator and Tools Co., Worthington, Ohio, has brought out a 2-wheel scraper which is controlled by one man from his driving position on the tractor.

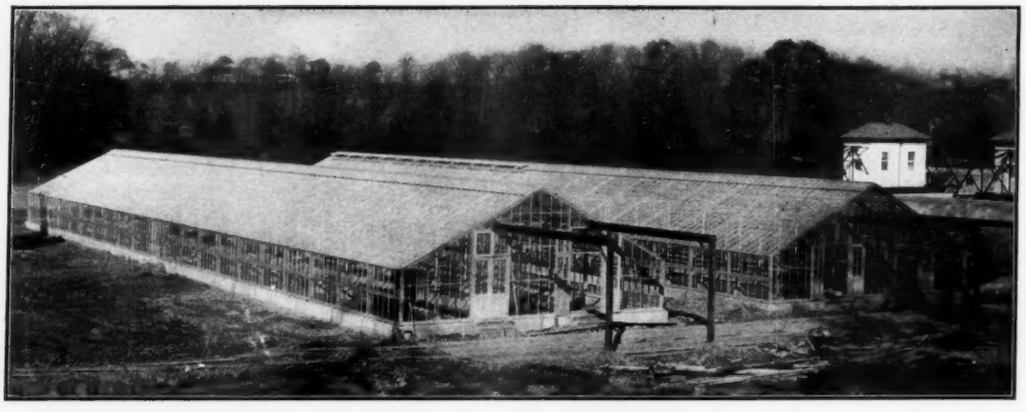
Operation of the bucket from digging to carrying to dumping and spreading positions is controlled from the tractor by means of a winch mounted on the rear end of the tractor. Noticeable among the construction features is the absence of gears, sprockets, rope connections or small moving parts which should minimize delays and repairs considerably. The cutting edge of the bucket is a detachable, reversible and adjustable high carbon steel knife. It is claimed that small boulders, etc., are sliced through with ease. The bucket may be adjusted to cutting depths up to 8 inches. The Shaw "True-Cut" digs, loads, hauls, dumps and spreads in a continuous operation.

It is built in three sizes: The size 20 which carries level full 1½ yards; the size 30 which carries level full 2¼ yards and the size 60 which carries level full 4 yards. Each size will actually carry a larger load when rounded up. The 60 carries 4¾ yards rounded up, taken from a cut 8 inches deep by 5½ feet wide by 34 feet long—if a shallower depth is made, the cut can be made longer. It is stated that one man with a Shaw "True-Cut" 60 attached to a tractor of the "caterpillar" or crawler type, can excavate, move and grade, over a haul up to two thousand feet for less cost per yard than any other equipment. One man with a 60 can move five hundred cubic yards of dirt four hundred feet in a ten-hour day at a cost of less than five cents per yard including ten dollars per day for depreciation and repair, it is said.

Nelson Jumbo Trench Pumps

Nelson Bros., Saginaw, Mich., manufacture the Jumbo trench pumps. This pump is especially designed for power drive and constructed to withstand the hard work imposed upon it. The diaphragm is made of the best quality rubber and is guaranteed for severe service. The suction valve is of metal, rubber faced and easily removed. It is set on an inclined seat and, therefore, offers the least obstruction to the pass-

Master Construction Glass-Overs for Sludge Beds



City of Elyria, Ohio Uses L&B Sludge Bed Glass-Overs for Sewage Disposal Plant

George B. Gascoigne, Engineer
A. A. Burger, Assoc. Eng.

"FROM the Imhoff tanks the sewage passes to the aerating tanks which are one hundred and sixty feet long, ten feet wide, and have a liquid depth of fifteen feet. An aeration period of four hours is provided. Air is supplied by two electrically driven centrifugal compressors, each having two thousand cubic feet per minute capacity. The aerated sewage passes through meters to two sludge settling tanks equipped with sludge removal mechanisms. The tanks are each forty-five feet square and twelve feet deep, and the sewage is retained two hours for settling out of the solids. From the sludge settling tanks the effluent flows directly to the Black River. Approximately twenty per cent of the sludge will be returned through the influent line to the aeration tanks. The excess sludge together with the sludge from the Imhoff or primary settling tanks will be mixed and placed in the two fifty foot circular digestion tanks, each equipped with floating covers and having a twenty foot water depth. These digestion tanks are provided with heating coils.

"From the sludge digestion tanks, sludge will be drawn by gravity to the covered sludge drying beds. There are two houses each thirty-six by one hundred and seventy-five feet in plan. Each of these houses is sub-divided into four beds. The sludge will be removed from the beds by means of a litter carrier operated upon an over-head trolley. The dried sludge may either be loaded onto trucks for use as fertilizer, or into industrial cars to be wasted in the vicinity of the plant."

The Sludge Bed Glass-Overs are Lord and Burnham's Master Construction.

Lord & Burnham Co.

Sludge Bed Glass-Overs

Graybar Building
New York City

208 So. LaSalle Street
Chicago, Ill.

Harbor Comm. Bldg.
Toronto, Canada

Branch Offices: Boston, Philadelphia, Irvington, Albany, Denver, Detroit, Cleveland, Kansas City, Buffalo, Greensboro, St. Louis, Montreal, St. Catharines.

For latest catalogs — consult the *classified* INDUSTRIAL LITERATURE section, pages 133 to 140.

age of semiliquid or solid matter. The lever operating the diaphragm is so designed as to lift the diaphragm vertically, thus eliminating the side motion that would tend to shorten its life and consume power.

The average overall height of these outfits is 28 to 30 inches.

The suction lift on these outfits ranges from 20 ft. to a maximum of 25 ft. under favorable conditions.

Contractors, bargemen and plumbers use these diaphragm pumping outfits on flooded trenches, ditches, cellars, sewers, foundations, cofferdams, irrigation systems; for bilge pumping on barges, lighters and schooners, and to pump any liquid or sewage no matter how gritty, sludgy or squdgy it may be.

The Unipump for all Drainage Work

The Union Iron Works, Inc., Hoboken, N. J., manufacture the Unipump which is a light pumping unit powered with an air-cooled engine. It is used for draining cellars, trenches, ships, catch basins, conduit manholes, cesspools, mines, cofferdams, quarries, etc.

The size 150 pump has a capacity up to 2,500 gallons per minute at 20 feet head. It is of the centrifugal, open impeller type, and will handle liquids containing sand, etc., up to 25 per cent of solids. It is direct connected to engine with suction and discharge 1½ inch, standard pipe threads. It weighs 105 pounds complete. It is provided with a foot starter, and will not tip when starting.

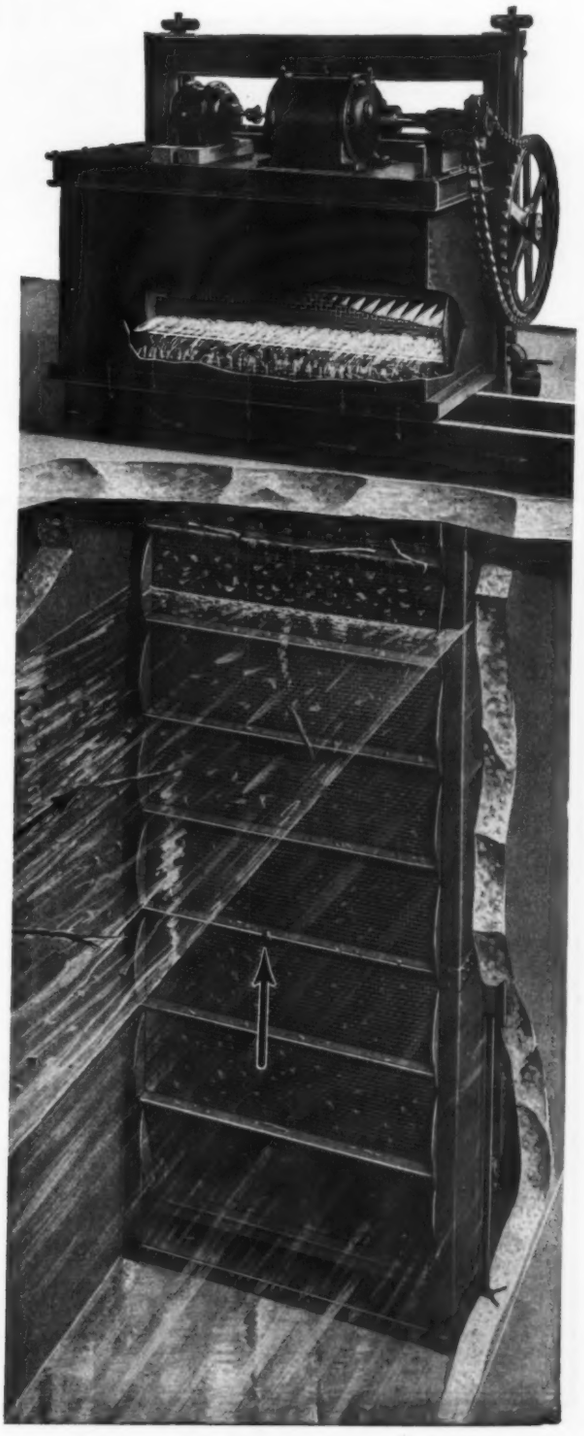
The size 200 unipump ranges in capacity from 500 gallons per minute at 55 feet head to 8,250 gallons at 20 feet. It weighs 180 pounds complete. This model has a rope starter.

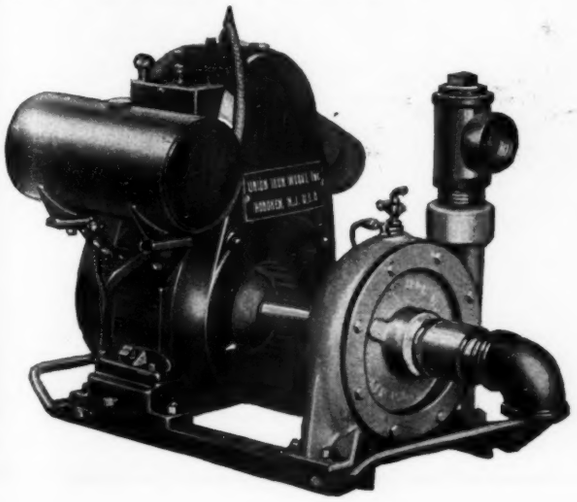
New Chain Belt Traveling Water Screen

A new type of traveling water screen embodying many new features will be put on the market by the Chain Belt Company, Milwaukee, this month. This screen is an entirely new development. It will be built at the company's plant at West Milwaukee. While the general principle of traveling water screens will be maintained the outward appearance of the screen itself has been definitely changed. It will occupy less space than heretofore and operate at a greater degree of efficiency than the ordinary type of water screen.

The two major improvements consist of a new basket design and a new base. These rectangular baskets hold the screen cloth (which may be of various constructions) and are in turn carried by two strands of Rex Chabelco hardened steel roller chain. The chain operates over head and foot sprockets. As the submerged screen surface becomes matted with the refuse, the screen is revolved. The refuse is then lifted from the intake by the upward travel of the baskets and is automatically removed by means of a powerful spray of water directed through the baskets from their rear, and which washes this refuse into a refuse trough. The spray of water serves to sluice the screen material away for disposal, usually on the down-stream side of the plant.

The second major improvement is the radically new design of the foot wheel, which permits the use of the new extended track shoe. This shoe engages the roller at the exact instant that it leaves the wheel. There is no intervening space in which the roller can weave inward, causing openings between the ends of the baskets and the frame of the screen.





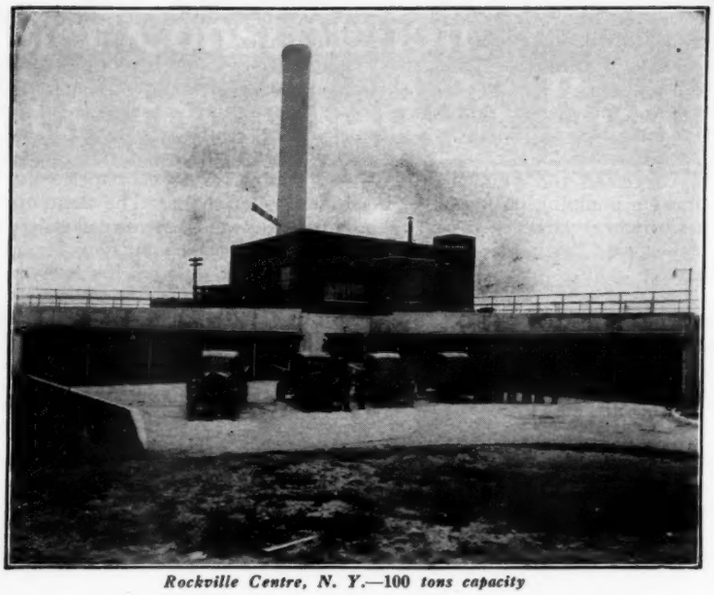
At Right: Link-Belt Traveling Water Screen; Below: The Unipump for All Drainage Work

ODORLESS
garbage disposal

The only satisfactory method of municipal garbage disposal is by high temperature incineration.

The Pittsburgh-Des Moines Incinerator

1. Operates at and above 1700° F.
2. Disposes of tons of garbage and rubbish without giving off odorous gases.
3. Builds up public health by sanitary disposal of garbage.
4. Saves money for the community by its economic operation.
5. Is guaranteed to operate satisfactorily.



Rockville Centre, N. Y.—100 tons capacity

Pittsburgh-Des Moines Steel Company

79 Neville Island, Pittsburgh, Penna. 683 Hudson Terminal Bldg., New York City. 981 Tuttle St., Des Moines, Iowa. Dallas, San Francisco, Seattle, Chicago, Atlanta

A new 24 page booklet containing data and information on municipal garbage disposal by incineration will be sent to you upon request. No obligations. Simply ask for Booklet No. 77

GIVE YOURSELF A PRIVILEGE!

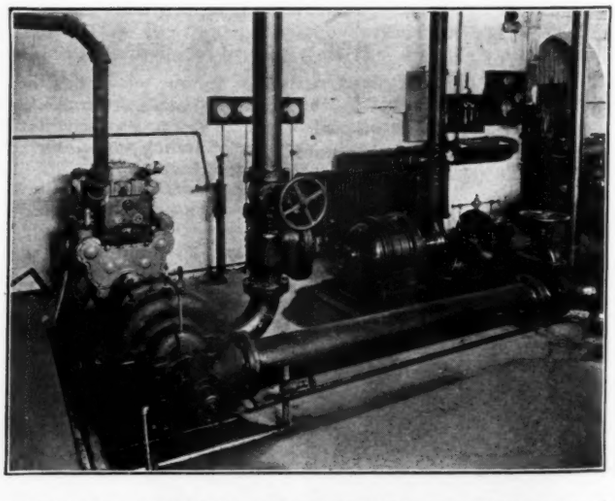
Before you invest in any emergency pumping unit, check it against what Sterling offers. See if you would feel safe without a Sterling.

Sterling High Duty

Sterling — The Engine of Refinement

Internal Combustion Engines

12 to 585 B.H.P.
Gas or Gasoline



Kingsville, Ont., 1200 R.P.M., DeLaval centrifugal pump direct connected to a 4 cylinder 120-150 HP, Sterling engine, 250′ head, 1500 R.P.M.

STERLING ENGINE COMPANY, Dept. C-5, Buffalo, N.Y., U. S. A.

For latest catalogs — consult the *classified* INDUSTRIAL LITERATURE section, pages 133 to 140.

Koochiching County, Minnesota, Has Recently Purchased Four Relay Model 40-A Units With Wood W-10 Bodies for Road Building and Maintenance

In addition to power plants these screens are used in chemical and industrial plants, glue works, beet sugar mills, water works, and public enterprises such as sewerage disposal plants, etc.

Two New Sterling Heavy Duty Trucks

The Sterling Motor Truck Company, Milwaukee, Wisc., announces the addition of two heavy duty rear four-wheel drive trucks to their line, designed to carry great loads at high speeds.

The Model EWS-40 has a capacity of 12 tons with a maximum total weight of body and load of 40,000 pounds. The engine is a sterling six with a Red-Head Ricardo combustion chamber, which it is claimed, reduces gas consumption and increases motor efficiency. It has a 5" bore x 5⅜" stroke, 677 cubic inch displacement and develops 126 h.p. governed at 1800 r.p.m. The four bearings are extra wide and the crankshaft is of chrome nickel steel, heavily cheeked and perfectly balanced. The oiling system is full pressure, while the governor is built-in as an integral part of the motor.

The frame has 9" heavy channel beams with wood-inlay, a patented Sterling feature which, it is claimed, reduces vibration and wear and tear of the truck, in addition to giving the frame added strength. Bolts are used throughout, instead of rivets. The steering gear is of the worm type, making the truck exceptionally easy to handle. The clutch is a heavy duty Brown-Lipe with 14 driving discs and 14 driven discs. Westinghouse air brakes are used, having 146 square inches of braking surface on each rear wheel. The emergency brake is mounted on the propeller shaft, and in all, the truck has a total of 700 square inches of braking surface.

The transmission has four speeds, augmented by a Sterling patented auxiliary transmission of 9 extra speeds, giving the truck 12 forward speeds in all. The maximum road speed with load is 30 miles per hour. The front springs have 14 leaves and the rear 20 leaves. The front axle is of I-beam construction, one-piece forging. The two rear axles are heavy duty Timken worm drive and full floating. The front axle has a clearance of 13 inches, the rear 10 inches. I-beam radius rods form the means of propulsion.

Standard tire sizes are 40" x 8" front and 40" x 8" dual rear, both pneumatics. Wheelbases are optional.

The other model is known as the Sterling EWS-36. It is of the same design and construction as the EWS-40, but is of 10 ton capacity. The chassis weight is 13,300 pounds and the maximum total weight with load is 36,000 pounds. The motor size is proportionately smaller, having a 4½" bore x 5¾" stroke and 549-cubic inch displacement. It is rated at 98 h.p., governed at 1850 r.p.m.

It also is equipped with a Sterling 12 speed forward arrangement and has a road speed with load of 33 miles per hour. The entire frame construction and tire sizes are the same as the EWS-40.

New Ingersoll-Rand Shank and Bit Punch

Ingersoll-Rand Company, 11 Broadway, New York City, announces a new shank and bit punch known as the 34SP Punch. It is designed to fit the No. 34 drill steel sharpener.

The feed cylinder, valve chest oiler and guide holder are constructed in one piece, and the valve chest is bushed. The short throw and easy reach of the operating lever greatly speed operations. Complete lubrication is maintained from one oil chamber.

Stuck pins are eliminated by the positive action, which drives the punching pin out of as well as into the steel which is held clamped in the sharpener during the operation. Combination shank and bit guides permit handling both bits and shanks on any one steel section without changing guides and assure the correct alignment of steel to be punched.

With a 34SP punch attached to the No. 34 sharpener the complete outfit will handle any section of drill steel up to 1⅛" in diameter and will make bits up to 2½" in diameter.

Link-Belt Announces "Hyper" Chain

Link-Belt Company, of Indianapolis, announces the development of a new steel drive chain which will be known as Link-Belt Hyper chain. It is made from alloy steel, heat treated, and uses a new type of pin and cotter. The pins, bushings and holes in side bars are accurately ground. The cotters are of a special type (patent applied for) and are so designed as not to work loose when once inserted and swelled into the holes provided in the pins for their reception.

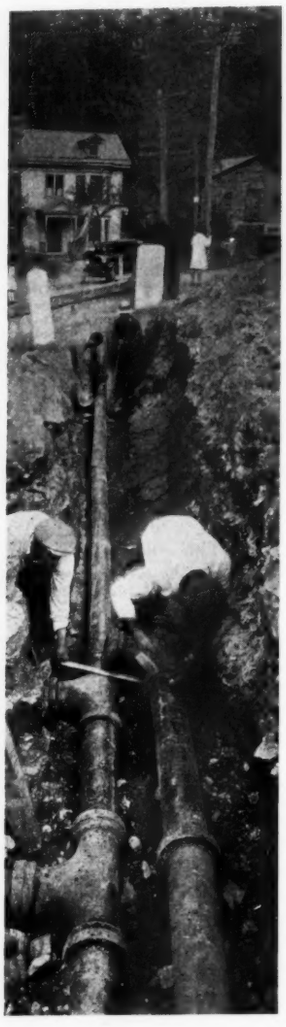
The new chain combines great strength with durability. The Link-Belt Hyper SS-40 Chain has an ultimate strength of 75,000 pounds, and the Link-Belt Hyper SS-124 Chain, an ultimate strength of 150,000 pounds.

The manufacturing tolerances to which these parts are held are extremely fine, .001", which insures press fits of the highest order, and such fits result in a durable chain.

The chain was developed to meet a growing need for a stronger and more durable type of chain for heavy positive power transmission.

Sterling EWS-40 With 6½-Yard Wood Dump Body

"In a Tough Spot"— USE McWANE PIPE



McWane Pipe's no mollycoddle. Tough jobs are where it and its famous Precalked Joints shine.

No matter how hard the going—how wet and irregular the trench, get rid of trouble by shelving your lead-pot and let the McWANE foundries do your joint-making for you.

With them, you merely "socket and 'sock' it"—assemble your pipe and calk the Precalked Joints for positive, uniform joints quickly made. Save time and money.

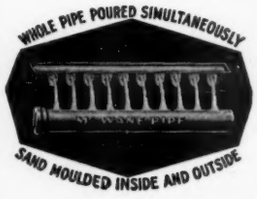
Precalked Fittings, too.

Sand Cast

McWANE pipe is sand cast—modern in weights and strengths yet old-fashioned in the way it cuts, taps, and ships. Bell and Spigot type.

1¼ and 2 inch Cast Iron Pipe

Why lay perishable pipe in small sizes when less money (per year) will give you CAST IRON McWANE Pipe in 1-¼, 2 and 3 inch sizes? End your rust troubles with it. Booklet.



McWANE CAST IRON PIPE

WRITE FOR ILLUSTRATED LITERATURE

McWANE CAST IRON PIPE CO. BIRMINGHAM, ALA.

PACIFIC STATES CAST IRON PIPE CO. PROVO, UTAH.

SALES OFFICES IN PRINCIPAL CITIES

New Western Rotary Stone and Gravel Crusher

The Austin Western Road Machinery Co., Chicago, Ill., has brought out the Western rotary crusher, a portable crusher that weighs only 6,000 pounds but that has a conservative rating of 20 to 30 cubic yards of one-inch gravel per hour requiring for the crushing, it is claimed, only 60 per cent of the power needed by other rock crushers of greater size and much less capacity.

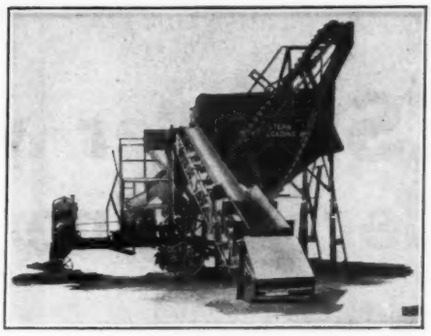
This crusher utilizes an entirely new principle in the crushing of stone. Strike with a hammer a stone that is suspended in air and it will readily break into cubiform pieces following the lines of stratification. An adaptation of this mechanical principle is said to give a cheaper machine of greater capacity which produces a high grade of crushed stone.

The frame of the Western Rotary Crusher is built up of structural steel shapes and plates. Within this frame a rotor, 20 inches in diameter, revolves at a speed of 1000 R.P.M. To the rotor are rigidly fastened three steel hammers, each 20 inches long, which in their rapid whirling barely clear a fixed die that is supported by a heavy casting. These hammers strike 50 blows per second against the rock as it falls through.

The only bearings on the entire machine are the two oversized self-aligning roller bearings supporting the rotor. These bearings are sealed in dustproof housings and require oiling but twice a week. The wear on hammers and die is taken up by means of shims back of the heavy steel casting which holds the die. No bolt has to be removed or loosened to insert these shims. The die can be replaced by two men in an hour's time and it will take one man only an hour to replace the hammers when such replacements become necessary.

To prevent possible injury should an unusually hard stone or piece of iron get into the crusher a heavy spring permits the die to "give" under pressure and, if this is not sufficient to clear the obstruction, the shearing of a small replaceable pin will allow the die to swing back out of the way.

In operation, stone is fed into the machine through a 9″ x 20″ opening. The falling stone is caught in mid-air



New Austin Western Crusher

by the revolving hammers which drive the broken cubes for further crushing, when necessary, between the faces of the hammers and the die. The hammers, however, do most of the work. The oversize material is spouted back to the crusher for re-grinding.

New Trackson Crawler Wheels

Simplicity, durability and easy, smooth-running operation are claimed as the outstanding qualities of the new Trackson crawler wheels, the most recent product of the Trackson Co., Milwaukee, Wis. These wheels are designed for installation on wagons and trailers to meet the heavy hauling requirements of every industry. Contractors, highway men, oil field operators, loggers, cane growers and many others find that no matter how bad the ground conditions, they can be depended upon to deliver their loads.

These wheels represent several notable improvements in crawler wheel construction, resulting in greater strength and resistance to wear. For instance, the tension members or links which hold the shoes in rigid rail position are made of extra-heavy drop forgings, especially heat-treated. These links function simply by moving to and fro within one another, without any turning or grinding action, and therefore will wear indefinitely. Small parts such as bolts or toggle-links are entirely eliminated in these wheels.

Another distinctive feature of Trackson crawler wheels is the take-up device which provides for tightening the track shoe loop by varying the wheel centers to suit different operating conditions. Since the shoe loops should be neither too tight nor too loose for most efficient operation this take-up device is important. Also, it is especially effective because of its simplicity and accessibility.

Split-type hardened steel bushings are used in the shoe hinges of these crawler wheels. These bushings are pressed into place and keyed in the lug to prevent turning. They are easily reversible or removable when worn.

Trackson Crawler Wheels may be installed on almost all makes of wagons. They are manufactured in four sizes, with six, ten, fifteen and twenty-ton load capacities respectively. The ten and fifteen-ton size wheels will be of special interest to contractors, since they can be used on wagons with from five to ten-yard capacities.

Sika—For Making Concrete Waterproof

The American Sika Corporation, 56 West 45th St., New York, are representatives for Sika. These waterproofing Sikas are liquids to be added to the mixing water in making portland cement concrete or portland cement plaster waterproof. They are made in various grades to suit varying conditions.

Sika No. 1 does not change the setting time of portland cement. It is added as an ingredient to the mixing water for waterproofing concrete or cement plaster. It should be diluted with 12 to 15 parts of water and kept well stirred. One gallon is used in waterproofing one cubic yard of concrete or 110 square feet of cement plaster, one inch thick.

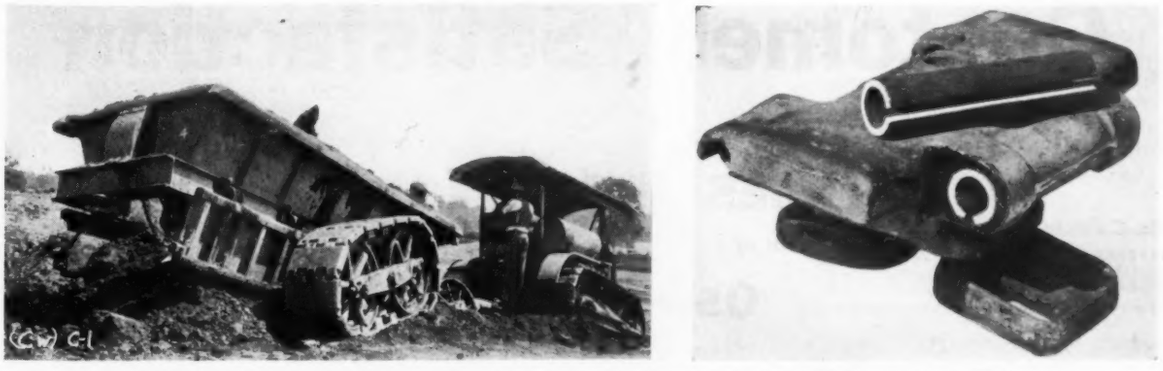
The other Sikas are both waterproofing and quick setting and give absolute control over the setting time of portland cement. They can be used for plastering with portland cement against running water without the necessity of relieving the pressure. They can also be used for sealing gushers.

Sika No. 2 is used for sealing gushers with Portland Cement.

Sika No. 4 is used for rapidly setting Portland Cement Concrete in running water conditions.

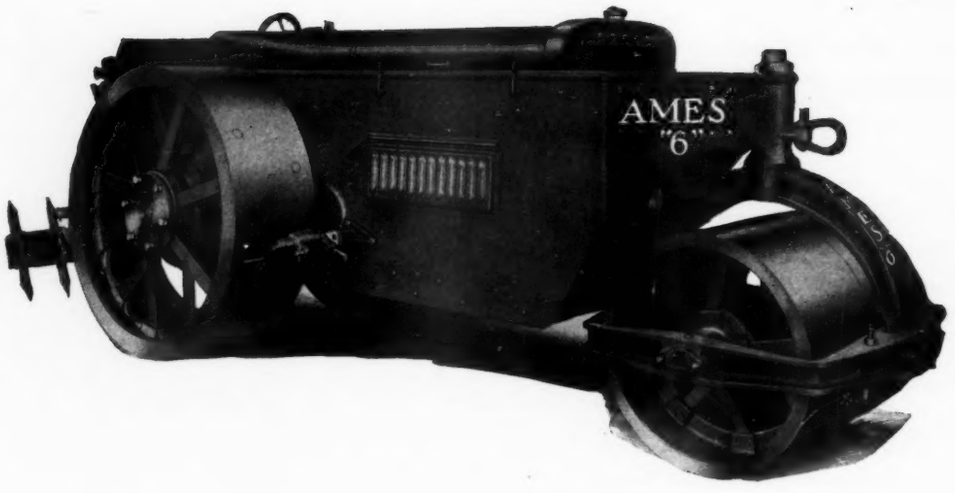
Sika No. 4A is used in plastering with Portland Cement against water infiltrations where pressure cannot be relieved.

There is also a special Sika for waterproofing porous brickwork without changing the appearance of the bricks.



Trackson Crawlers for Heavy Hauling, Showing Steel Bushings Used in Shoe Hinges

The AMES Roller with Six Cylinder Engine



Fully enclosed Transmission. All parts running in oil.
Built in Spur Gear Differential with lock.
Self Starting. No cranking necessary.
Complete freedom for operator.
Wide variation of speeds.
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Six Cylinder motors only

AMES IRON WORKS
Division of Pierce, Butler & Pierce Mfg. Corp.
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5, 7, 10 and 12 Ton Sizes

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Diesel Handles 500 to 600 Cu. Yds. Per Day at Less Than 5c Per Yard

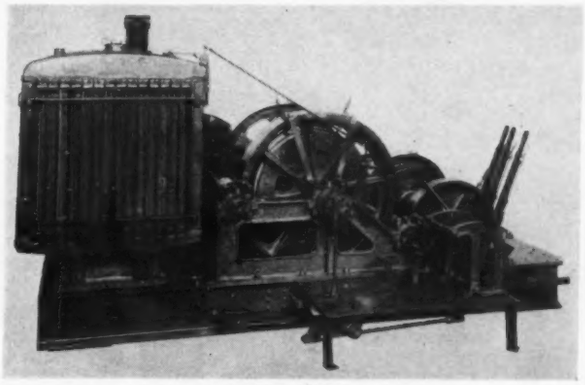
An interesting example of economical power and the use of the Buda-M. A. N. Diesel in movable operations is furnished by the Inter-County River Improvement of Tacoma in their dredging work on the Stuck River.

The Inter-County River Improvement conducts joint operations in dredging and building levees on rivers dividing King and Pierce counties, Washington. The boards of county commissioners of the two counties serve as the board of control, with Chief Engineer H. F. Gronen in actual charge of operations.

The work consists of removing very large gravel from the channel of the Stuck River, pulling it to the bank, and building it up to form a levee. Since the outfit works along the soft banks of the river and must be moved every two or three hours, light weight without sacrifice of available power was essential in selecting the power unit.

Last fall the board purchased a 120 H.P. Buda-M. A. N. Diesel engine mounted on steel frame with, and driving, a double drum two-speed hoist. This machine operates a 3-yard heavy duty dragline bucket. It was placed in operation November first, and has been operating since.

In commenting on these operations, Mr. Gronen states that: "The average haul is about 500 feet, the last 100 feet being pulled up on about 3 or 4 to 1 slope. The machine has been handling the bucket at a speed of 325 feet per minute in high gear without difficulty. Fuel consumption per day is approximately 40 gallons of Diesel oil at 4c per gallon. Total approximate cost per day, including fuel and lubricating oils, labor, wire rope, and upkeep, amounts to about $24.00. Yardage handled averages between 500 and 600 cu. yds. per day, or an average cost of less than 5c per yard."



Type of Diesel Engine Used on Inter-County River Improvement Work

A Link-Belt K-35 Gasoline Crawler Dragline Cleaning Out a Drainage Ditch at Houston, Tex. It Was Necessary to Remove 107,000 Cubic Yards of Sand. James G. Donovan Was the Contractor. The Dragline Has a 50-Foot Boom and a 1-Yard Bucket

Public Reports

United States Magnetic Tables and Magnetic Charts for 1925.—This publication contains the observed values of the magnetic declination, dip, and horizontal intensity for all places in the United States at which reliable observations have been made, together with corresponding reduced values for January 1, 1925; tables giving the results of observations at repeat stations occupied between January, 1917, and December 1928; tables giving the change of the magnetic elements with time; and magnetic charts showing graphically by means of isomagnetic lines the general distribution of the declination, dip, horizontal intensity, and vertical intensity in the United States at the beginning of 1925. The scope of the publication is perhaps best shown by its table of contents which follow: Introduction; available data; secular change data; secular change tables; reduction to epoch; contents of table of results; accuracy of tabular values; construction of the magnetic charts; lines of equal annual change; results of observations at repeat stations; tables for reducing results to January 1, 1925; observed values of magnetic elements and corresponding values for January 1, 1925.

The publication is sold only by the Superintendent of Documents, Government Printing Office, Washington, D. C. The sale price is 60 cents. Stamps will not be accepted by the Superintendent of Documents in payment for publications.

Philadelphia Hospital and Health Survey.—This 844-page report reviews the result of a survey of the health and hospital facilities available in Philadelphia, which was carried on by a committee of which Dr. Haven Emerson was director and Sol Pincus and Miss Anna C. Phillips associates. The survey, which was carried on between November, 1928, and June, 1929, covered principally care of the sick, the official health services, and the volunteer health activities, but also gives data on the status of sanitation, sewage treatment, water supply, housing, and food and milk control.

Industrial Notes

Jeffrey Manufacturing Company, Limited, at its annual meeting in Montreal, elected John L. Connors, director

THE CLEVELAND PIONEER

Increasing Trencher Usability— Decreasing Digging Costs

Besides digging a 30 inch trench up to 10 feet deep within 14 inches of trees, poles, etc., at either or both sides of the machine; besides being easy and economical to transport from location to location, thus giving you all the economies of machine trenching on your smaller and more widely scattered jobs; besides being powerful enough to cut easily and efficiently through the hardest and toughest soils, always having reserve power for the unusual job; besides giving fast service because of its abundant power, anti-friction construction and rugged digging mechanism, all making for fast digging; the Cleveland Pioneer delivers to owners a big added value and economy through the Pivot Conveyor, for this exclusive, patented feature affords complete control over the disposal of excavated material.

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This conveyor affords the following advantages:

1. Loads surplus material direct into trucks or wagons in front of or at either side of machine.
2. When working over rough ground, dirt can be discharged over front of machine, for leveling up its right of way, thus eliminating a great deal of labor.
3. Handles any amount of dirt which the machine will be called upon to dig.
4. Instantly adjusted to place spoil bank where required, at either side and at sufficient distance from machine.
5. Eliminates necessity of hand shoveling dirt away from discharge end of conveyor.

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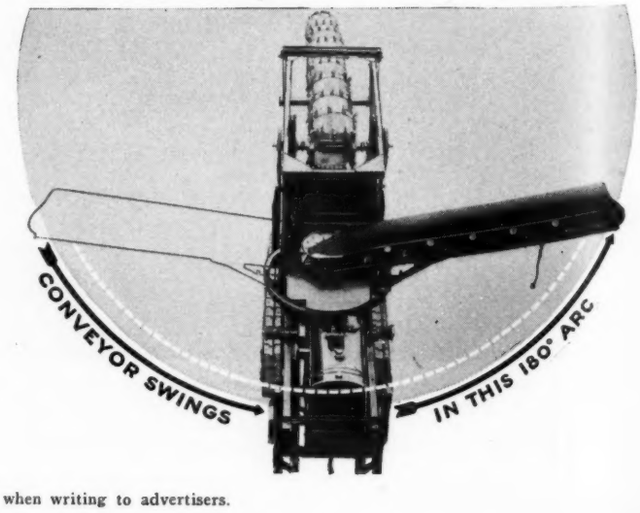

Two of These Ford 6-Wheel Dump Units With Wood 6-Yard Bodies Are Used in Las Vegas, Nevada, to Collect Dry Garbage and Trash and to Pick Up Garbage From Restaurants and Carry It to a Hog Ranch Six Miles Out

G M C T-60 Truck Operated by the City of Akron, O. It Is Equipped With a Low-Mounted Wood Body to Make Hand Loading Easy

and vice president. R. H. Ross was elected secretary-treasurer to fill the vacancy caused by the recent resignation of F. N. Diehl, former secretary. Robert W. Gillespie is president of the Company. The new plant of the Company at Montreal has been completed, and Jeffrey equipment is now being manufactured and assembled in Montreal, and a complete stock of conveyor equipment is available to serve the Canadian market.

Link-Belt Company, 300 W. Pershing Road, Chicago, announce the appointment of the Idaho Equipment Company, 118 Main Street, Boise, Idaho, as agent handling their complete line of cranes, shovels, draglines as shown in Link-Belt Book No. 1095 now being distributed.

The Heltzel Steel Form and Iron Company, Warren, Ohio, announces the appointment of B. M. Clark as manager of sales, to succeed W. J. Savage, who recently resigned.

Heavier tires are now supplied as standard equipment on all Dodge Brothers half-ton trucks. The size has been increased from 20 by 4.75 to 20 by 5.00 according to an announcement by the truck division of the company, which points out that the added tire capacity increases the roadability and carrying capacity of the half-ton trucks.

The Chain Belt Company of Milwaukee, Wisconsin announces the appointment of the Corbin Supply Company of Macon, Georgia, as representatives for their complete line of chain and transmission equipment.

Civil Service

Junior Cartographic Engineer.—Applications must be on file with the Civil Service Commission at Washington, D. C., not later than May 28, 1930. The examination is to fill vacancies in the Coast and Geodetic Survey, Department of Commerce, for duty in Washington, D. C., or in the field. The entrance salary is $2,000 a year. The duties consist of the utilization of the data resulting from the field surveys of the Bureau, or obtained from a wide variety of miscellaneous sources, in the compilation and correction of nautical charts which guide all vessels traversing the navigable tidal waters of the United States and its possessions, and of other professional work in related physiographic problems. Competitors will not be required to report for examination at any place, but will be rated on drawing and lettering, material for which will be furnished by the Commission to applicants after their applications are filed.

Physicist.—Applications must be on file with the Civl Service Commission, Washington, D. C., not later than May 28, 1930. The examinations are to fill vacancies in the Bureau of Standards and Bureau of Mines, Department of Commerce, and under the National Advisory Committee for Aeronautics, and in positions requiring similar qualifications in other branches of the service. The entrance salaries are $3,800 a year for physicist, $3,200 a year for the associate grade, and $2,600 a year for the assistant grade. The optional subjects are (1) heat, (2) electricity, (3) mechanics, (4) optics, (5) radio, (6) physical metallurgy, (7) thermodynamics, and aerodynamics, or (8) any specialized work in the field of physics not included in any of the above.

Competitors will not be required to report for examination at any place, but will be rated on their education and experience, and writings to be filed by the applicant.

Information.—Full information may be obtained from the United States Civil Service Commission at Washington, D. C., or the secretary of the United States Civil Service Board of Examiners at the post office or customs-house in any city.

BOOKS AND BOOK REVIEWS

American Civil Engineers' Handbook. Thaddeus Merriman, editor-in-chief; Thos. H. Wiggin, associate editor-in-chief; and 19 associate editors. John Wiley & Sons, Inc. Fifth Edition. 2263 pages. Illustrated. (In one volume or two). $8.

While following the general plan and scope of the first four editions, the fifth edition has been revised, enlarged, and brought up to date. The order of the sections has been changed to provide a more logical arrangement, so that in this edition the first eleven sections present general principles and materials, and the second eleven treat of principles, design and application in the several fields.

It is expecting too much of a reviewer to read the 2164 pages of small type (the index takes up 99 pages), and this reviewer has not done it. Several sections have been read, and the text will be judged on these, so far as this review goes. It is always a temptation, of course, to call attention to inadequate treatment of favorite (to the reviewer) topics, or to a lack of the very latest data on these subjects. Such a one comes to mind in the section on earthwork, where it is stated that tower machines have been very successful on the new larger Mississippi levees, whereas this is not the case. The new section levees have about put the tower machine out of business. A sanitary engineer might complain of the relatively small space given over to sewerage, or refuse, or even to water supply, which fares better, though it has but 74 pages of space. This section, which was done by Allen Hazen is, by the way, one of the best in the book.

But if one takes this view of such an excellent work,

HOME

SEWAGE DISPOSAL

By W. A. HARDENBERGH
Associate Editor of Public Works

It fulfills a long existing need in supplying reliable facts and information for engineers, city officials and others who are interested in solving sewage disposal problems for single homes, small communities, and institutions. It stands alone as the only engineering book covering thoroughly the problem of sewage disposal of unsewered communities. Chapters on small septic tanks, small Imhoff tanks, secondary treatment, construction, etc. 82 illustrations; 280 pages, $3.50.

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he is hard to please. The real purpose of a handbook like this is to provide the busy engineer, who cannot carry with him (or perhaps afford) a complete library, the basic and important facts on *every* subject that may come within his field. From this book, he can get the fundamentals and many late and important facts about any branch of work.

As a reference book, Merriman's American Civil Engineers' Handbook should be in the library of every engineer. There is no place where there can be secured such a wealth of valuable information for the price asked for this text.

Flood Flows.—By Allen Hazen, John Wiley & Sons, Inc., New York. 199 pages; 56 illustrations; $4.

This book is, it is stated, the result of more than 20 years' study by the engineering office of Hazen & Whipple. In addition to his own research, Mr. Hazen has gathered together in one compact and comprehensive presentation the material and methods previously published that have proved most helpful in dealing with the problem of floods and their control.

The important and fundamental data have been arranged in a form convenient for reference. Throughout the book have been added bits of information that are obtained elsewhere only with difficulty. We believe that civil engineers will find this work invaluable as a source of information on the size and recurrence of flood flows.

It is written, throughout, in Mr. Hazen's own pleasing style. It delves rather deeply into mathematics, and is scarcely a book for light reading; but, as a text for reference and study in regard to flood flows, it fills a long-existing gap.

Elements of Topographic Drawing. By Roscoe C. Sloane and John M. Montz. First Edition, 182 pages, 93 illustrations. McGraw-Hill Book Co., N. Y. $2.75.

The authors, both of whom are teaching at Ohio State, Prof. Sloane in highway engineering, and Prof. Montz in civil engineering, have been using the materials from which this text was prepared for several years. The text has been designed to use as a basis for a course of instruction, and as a reference book for topographic draftsmen. All the plates and illustrations have been drawn by the authors.

The second chapter is devoted to a list of conventional signs and symbols. This is very extensive, covering almost every variety of vegetation or material, such as banana trees, corn, alfalfa, coral reefs, mine dumps, trails, all kinds of bridges, etc. Military symbols are also included, as well as aerial.

The third chapter covers methods of topographic mapping, the fourth topographic drawing in colors, and the fifth contours and contour sketching. Then is given valuable information on copying, duplication and reproductions, while the final chapter covers suggestions for office practice.

This is an excellent book, all the more valuable because it reflects the amount of work and thought put on it.

Masonry Dams. By W. P. Creager. John Wiley & Sons, Inc. 350 pages. Illustrated. $4.

This is the second edition of a work that has been standard for some 15 years. There are few things in it with which a reviewer may find fault, as it covers the matter of the design of masonry dams very thoroughly. It is scarcely a book for the beginner, for Mr. Creager assumes that his readers possess a cer-